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MONTHLY REPORT

ON THE NUCLEAR FUEL MARKET

NUEXCO

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MONTHLY REPORT ON THE NUCLEAR FUEL MARKET

November 1984 No. 195

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To Our Readers

We are pleased to announce that Mr. **Ralph O. Smith** has joined Nuexco as a representative. Mr. Smith retired on November 1, 1984 from his position as vice president of Purchasing and Materials Management at Northeast Utilities Service Company and he brings valuable expertise to the Nuexco staff.

Mr. Smith was graduated from Purdue University in 1950 with a bachelor of science degree in electrical engineering, beginning his utility career at the Connecticut Light and Power Company at that time. In 1960 he began a career in purchasing that led in 1976 to his becoming Director of Purchases for the Northeast Utilities Service Company (NUSCO). He became a vice president in June 1981. Mr. Smith is a current member of the American Nuclear Society as well as the National Association of Purchasing Management, Inc. (NAPM); in addition, he is on the Executive Committee of the Public Utility Buying Group of NAPM. He received the Cheshire (Conn.) Chamber of Commerce's Outstanding Service Award in 1976.

* * *

Nuexco will host a hospitality suite during the Atomic Industrial Forum's Annual Conference in Washington, D.C., November 11–14. We look forward to seeing you there.

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NATURAL URANIUM AND SECONDARY MARKET CONVERSION

The **Exchange Value** as of October 31, 1984 is **$16.00** per pound U_3O_8, down $1.50 since last month. **Active supply** of natural uranium (U_3O_8 and UF_6) for spot or near-term delivery totals **5,450,000** pounds U_3O_8 or equivalent UF_6, down 40,000 pounds since last month. The corresponding figure for **active demand** is **1,275,000** pounds, up 320,000 pounds. The spot and near-term **supply-demand ratio** fell to **4.3:1.**

The *Current Market Data* section of this Report lists eleven uranium sales transactions, involving a total of approximately 1,600,000 pounds equivalent U_3O_8. Four of those sales involved natural UF_6, and one involved enriched uranium. All of the transactions reported this month involved deliveries before 1986, and five met the criteria for inclusion in the current Transaction Value calculation.

The **Transaction Value** as of October 31, 1984 is **$16.05** per pound U_3O_8, down $0.50 since last month. The current Transaction Value includes 10 transactions involving a total of 2.7 million pounds U_3O_8 or equivalent UF_6 and covers a period of 5 months.

The **Loan Use Charge Rate** as of October 31, 1984 is **6 percent** per annum, unchanged since last month in a nearly dormant market.

* * *

October's nine percent decline in the Exchange Value was a direct result of the persistent excess of supply over demand characteristic of the current uranium market. That factor manifested itself in two distinct ways.

1. Several sellers made offers well below last month's Exchange Value.

2. Generally, offers in the $16.00-16.50 range still failed to interest buyers.

In this nearly saturated market, almost all demand that does exist is discretionary, as opposed to fundamental. Thus, it has become necessary for sellers to offer especially attractive prices and terms to stimulate interest.

Low market prices and a lack of substantial demand have dissuaded several potential sellers, particularly those producers and users having large, unneeded inventories, from seriously entering the market. Most of the uranium transactions reported this month involve almost immediate deliveries. The frequency of nearer-term transactions in recent months may be attributed to several factors.

1. Having completed their analyses of DOE's offer of the Utility Services enrichment contract (USEC), certain utility fuel managers could turn their attention to the purchase of feed material for the purpose of immediate forward supply.

2. The approach of the end of secondary market in FY85 SWUs may have stimulated some utilities to obtain inexpensive uranium concentrates and proceed with enrichment as quickly as possible.

3. Several of the reported transactions occurred in mid-1984, but were not finalized until this month.

With buyers firmly resisting any upward movement of prices, sellers of spot or near-term material generally will come from three categories:

1. Producers having lower production costs who, due to cash needs or other financial considerations, choose to compete more vigorously for the limited available business;

2. Inventory holders that expect prices to drop lower soon;

3. Inventory holders that have overriding reasons for liquidating, regardless of market conditions.

* * *

The **Conversion Value** is **$1.00** per pound U in UF_6, unchanged since last month. Active supply of secondary market conversion services for delivery within three years amounts to 1.2 million pounds U in UF_6. No active secondary market conversion demand for delivery within three years, and no secondary market conversion transactions, are reported.

The sale of natural UF_6 to buyers that prefer natural uranium concentrates often requires sellers to discount their offering prices substantially, primarily by pricing the conversion services contained therein virtually at zero. October uranium sales supported that premise, as conversion was usually free for buyers of natural UF_6. Nevertheless, any buyers seeking to purchase conversion services on the secondary market would be facing prices of approximately $1.00 per pound U in UF_6.

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PRICING

ENRICHED URANIUM AND SWUS

The Nuexco **SWU Values** as of October 31, 1984 are unchanged from last month:

1. For **DOE origin** and a tails assay of 0.30 weight-percent U_{235}:
    a. For FY85 delivery, $115 per SWU;
    b. For FY86 delivery, $20 discount from the USEC base price on delivery;
2. For **non-DOE origin:**
    a. For delivery within approximately 15 months, $90 per SWU;
    b. For delivery in CY86, $98 per SWU.

Eight secondary market SWU transactions are reported, involving 620,000 SWUs. Active secondary market SWU supply amounts to 650,000 SWUs, while active demand totals 170,000 SWUs.

* * *

Secondary SWU market activity for several months has been overshadowed by DOE customers' analysis of the USEC offer, reactions to it, and negotiations of conversion terms. Because October 1 was the nominal deadline for conversion to the USEC, almost all nuclear utilities have by now completed their basic long-term planning for enrichment services. Most have signed long-term contracts with one or more primary suppliers that will match SWU deliveries closely to reactor requirements. As a result, many fuel managers will be able to reduce their inventory levels and fuel costs for the long term.

Competition in both primary and secondary markets has been the principal driving force behind the development of contract terms more favorable to utilities. Nevertheless, most buyers' recent contract decisions have been heavily influenced by national political concerns. For example, almost all US utilities, and all of DOE's Japanese customers, have signed new contracts with DOE. The French, Italians and Belgians will receive most of their requirements from Eurodif; and most deliveries to British, Dutch and German utilities will come from Urenco.

In a few cases, European buyers signed the USEC against their apparent national interests. This was the case most pointedly with ENUSA, a Eurodif shareholder, which converted AFCs for nine units to the USEC. The dominant motivation was economic, in that DOE gave ENUSA favorable terms for assigning or otherwise reducing inventories held at DOE. Also, certain German utilities signed new contracts with DOE under favorable terms.

Last month, Report 194 discussed DOE objectives and marketing strategy. It also presented a partial list (Table 1 on page 3) of DOE sales losses from contract cancellations, using DOE data (as of March 1984) presented to Congress in August. Certain portions of the data require further explanation:

1. ENUSA sent DOE notices of cancellation of its AFC contracts from 1992 onward (i.e., with zero termination charges). One notice, covering the bulk of ENUSA's reactors, was sent in 1983. The second notice, covering the balance of ENUSA's AFC contracts, was sent in May 1984. Those notices were rescinded as part of ENUSA's negotiations with DOE to convert to the USEC. Recently, DOE released a list of non-US customers that converted to the USEC that indicated ENUSA had converted to the USEC at 100 percent of requirements. That is misleading, in that it ignores the fact that Eurodif will cover 30 percent of requirements for DOE-supplied units when the DOE portion drops to 70 percent at a future date. It also ignores the fact that Vandellos 2 and Trillo 1 will be supplied by Eurodif, with some USSR deliveries.
2. Leibstadt and Goesgen, both undecided as to replacement supplier as of the date of the table (Report 194, page 3, Table 1), later signed contracts with Cogema.

The following is a review of the current status of enrichment services coverage by primary suppliers, now that almost all conversions to the USEC are known. Table 1 summarizes the data.

Europe

Belgium—Synatom owns 50 percent of SOBEN (Belgium Enrichment Group), which owns 11.1 percent of Eurodif. Having canceled future deliveries under its 3.5-year Requirements contracts (DOE) for Doel Unit 1, Doel Unit 2 and Tihange Unit 1, Synatom is covered 100 percent by Eurodif enrichment. That amounts to 3,450 MWe (5 units) in 1984 and will grow to 5,450 MWe (7 units) by 1990. The two additional units will also be covered by Eurodif.

Finland—TVO and IVO will accept all of their enrichment needs from the USSR.

France—Cogema, the principal shareholder in Eurodif, supplies all enrichment services for Electricite de France (EDF); both are state-owned companies. All but two units receive enrichment from Eurodif; the two exceptions are Fessenheim Unit 2 and Bugey Unit 3, which are covered by AFC contracts with DOE. As of November 1, 1984, Cogema had not signed the USEC.

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Table 1
ENRICHMENT SUPPLIERS' CURRENT MARKET SHARES

	Nuclear Electric Generating Capacity Estimate for Reactors Using Enrichment Services			Enrichment Coverage by Primary Suppliers[2], [3] (market share in percent)				
	No. of Operational Reactors	MWe	Capacity as Percentage[2] of Total	DOE	Eurodif	Urenco	USSR	None
Europe								
Belgium	5	3,450	2.2	0	2.2	0	0	0
Finland	4	2,220	1.4	0	0	0	1.4	0
France	31	28,050	17.6	note 4	17.6	0	note 5	0
Germany (FRG)[3]	14	13,567	8.5	2.7	0.5	3.3	1.5	0.6
Italy	2	1,135	0.7	0	0.7	0	0	0
Netherlands	2	495	0.3	0.3	0	0	0	0
Spain	6	4,270	2.7	2.7	0	0	0	0
Sweden	10	7,325	4.6	4.4	0	0	0	0.2
Switzerland	5	2,882	1.8	1.4	0	0.2	0	0.2
United Kingdom[3]	7	4,350	2.7	0	0	2.5	0.2	0
Yugoslavia	1	615	0.4	0.3	0	0	0	0.1
Total	87	68,359	42.8	11.8	21.0	6.0	3.1	1.1
Far East								
Japan[6]	28	19,829	12.4	12.4	note 7	0	0	0
Korea	2	1,185	0.7	0.7	0	0	0	0
Taiwan	5	4,017	2.5	2.5	0	0	0	0
Total	35	25,031	15.7	15.7	0	0	0	0
Other Countries								
Brazil[8]	1	626	0.4	0	0	0	0	0.4
India	2	400	0.2	0	0.2	0	0	0
South Africa[8]	1	922	0.6	0	0	0	0	0.6
Total	4	1,948	1.2	0	0.2	0	0	1.0
United States	80	64,458	40.3	31.8	1.0	0.4	0	7.1
World Total	206	159,796	100.0	59.3	22.2	6.4	3.1	9.2

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[1] While SWU demand is related to generating capacity, reactors of the same size can have different SWU needs, depending on type, reload cycle, and various other physics factors. Nevertheless, in the aggregate, generating capacity is a useful indicator of *relative* market size. Thus, Belgium for example, having 2.2 percent of the world's current operational nuclear generating capacity, represents *approximately* 2% of the world market for SWUs.

[2] Columns and rows may not add to totals, due to independent rounding. All percentages refer to status as of 1984.

[3] Reactors covered by more than one supplier were arbitrarily weighted by Nuexco.

[4] As of November 1, 1984, Cogema had not signed the USEC.

[5] Cogema contract with USSR covers small percentage of SWU requirements.

[6] All Japanese reactors currently operating are supplied mostly by DOE. Some converted to the USEC at 70 percent. The effects on Japan's large advance purchase of DOE SWUs are not yet known.

[7] Several Japanese utilities have non-DOE contracts in addition to their DOE contracts.

[8] Brazil and South Africa's enrichment needs are being filled from inventory. Plans are to supply future enrichment needs domestically.

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Cogema also has a contract with the USSR for a small fraction of EDF's future needs.

Germany (Federal Republic)—The nine FRG utilities operating nuclear power plants have among them thirteen units in commercial operation and nine under construction or in the startup/power ascension process. Urenco will supply the bulk of the long-term requirements for at least 14 of the 22 units. For the nearer term, seven units are covered by DOE contracts (two Requirements, one AFC, and four USECs); nine are covered by Urenco, five by the USSR, and one by Eurodif. One of the units covered by the USEC, HKG 300 (a thorium high-temperature reactor), has already enriched its inventory (93 percent U_{235}), so it will not be a market factor for the near term.

Italy—ENEL, a Eurodif shareholder, has Eurodif coverage for all reactors operating or under construction.

Netherlands—PZEM converted its abbreviated 5-year Requirements contract to the USEC for its only commercial-sized operating unit, Borssele. However, Urenco will assume deliveries later in this decade.

Spain—ENUSA, a Eurodif shareholder, converted to the USEC all nine of its AFCs, including two for the indefinitely delayed Lemoniz units. ENUSA had given notice to DOE for termination of its AFCs after 1992, but in negotiations late this summer, the two parties reached agreement on terms for conversion. Eurodif will furnish enrichment for Vandellos Unit 2 and Trillo Unit 1, and may supply some portion of ENUSA's other requirements at a later date. ENUSA also has a small contract with the USSR.

Sweden—OKG did not convert to the USEC, so Oskarshamn Units 1 and 2 continue to be supplied by 3.5-year Requirements contracts. The USSR will provide enrichment for a third unit due to begin operation in 1985, Oskarshamn 3. SSPB, which operates both the four-unit Ringhals station and the three-unit Forsmark plant, will continue to be covered by five AFC and two 3.5-year Requirements contracts. Sydkraft converted its Requirements contracts (one 3.5-year and one 5-year) to the USEC. The Swedish utilities will take delivery of a large number of SWUs from Eurodif later in this decade under a contract with Eurodif's Italian shareholders.

Switzerland—BKW converted a 3.5-year Requirements contract for its operating unit (Muehleberg) to the USEC, and also the AFC contract that covered the planned Graben unit. KKL converted its AFC to the USEC for deliveries until a contract with Cogema commences later in this decade. KKG signed a long-term contract with Cogema to succeed its AFC. Kaiseraugst is also covered by Eurodif. NOK has one contract with Urenco, and as of November 1 was not known to have converted its 3.5-year Requirements contract to the USEC.

United Kingdom—Both CEGB and SSEB are covered primarily by Urenco, with a portion of requirements coming from the USSR.

Yugoslavia—Krsko signed the USEC for its only unit.

Far East

China will not need any enrichment before 1990. Commercial arrangements have not yet been established for future enrichment needs. Some observers think that China has stockpiled substantial enriched uranium from their own process.

Japan—All DOE customers converted to the USEC, with three or four utilities electing 70-percent coverage. The Japanese situation is complicated by several factors:

1. Large SWU commitments associated with advance purchases made years ago. Scheduled deliveries over the next five years amount to approximately 4,000,000 SWUs.
2. Substantial purchases from Eurodif that are not needed to supply reactor requirements.
3. Inventories arising from past purchases under AFCs for reactors that are not due to start operating in this decade. Terms of conversion to the USEC, especially insofar as they allow the substitution of inventories, will be critical to the future SWU supply situation in Japan.

Korea—Two operating units, plus four units scheduled to begin operating by 1990 were covered by AFC contracts; all were converted to the USEC for 100 percent of requirements. Two other units under construction (Ul Jin-Kun 1 and 2) will be covered by Eurodif.

Taiwan—Taipower converted one 5-year Requirements contract (Chin-Shan 1 and 2) and four AFCs to the USEC. Yenliao 1 and 2 will be covered by Eurodif.

Other Countries

Brazil had a DOE 5-year Requirements contract for Angra dos Reis Unit 1, but it has been suspended. Nuclebras (Empresas Nucleares Brasileiras S.A.), in conjunction with Kraftwerk Union (KWU), is developing a domestic enrichment capability using the Becker jet-nozzle separation process. A demonstration plant with a capacity of 200,000 to 300,000 SWUs per year is under construction at the Resende fuel cycle complex. Once scheduled to start in 1983, the plant has been delayed repeatedly.

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India—DOE reached an agreement with India's Department of Atomic Energy to terminate its DOE contract, and France agreed to supply enriched UF_6 from Eurodif until 1993. Only the two 200-MWe Tarapur units use enriched uranium; the other four reactors (three operating, one under construction), being Pressurized Heavy Water Reactors (PHWR), use natural uranium.

Mexico—Anticipating Mexico's acceptance of the USEC, DOE allowed the Comision Federal de Electricidad (CFE) to terminate its AFC contracts due to overcommitment. CFE has since signed the USEC for 100 percent of its requirements. However, operation of neither Laguna Verde unit is imminent, so CFE's enrichment demand is not reflected in Table 1.

South Africa—DOE suspended two AFC contracts the Electric Supply Commission (ESCOM) had held since 1974. The Nuclear Nonproliferation Act of 1978 had prevented the export of uranium enriched under the contracts because South Africa had not accepted full-scope safeguards. The suspension was requested by the State Department after South Africa's Atomic Energy Corp. agreed that it would require safeguards as a condition of exporting nuclear material or technology. Having purchased at least enough enriched uranium to supply the initial cores for its two Koeberg units, ESCOM believes it has enough forward supply of enriched uranium to last until a domestic enrichment plant is operating. (The Atomic Energy Corp. is developing the Helikon jet-nozzle process for an enrichment plant.)

United States

Several US utilities rejected the USEC. Boston Edison signed a long-term contract with Urenco; Yankee Atomic, Maine Yankee and Vermont Yankee signed contracts with Cogema. American Electric Power (AEP) and Pacific Gas & Electric have chosen not to convert. Sacramento Municipal Utility District (SMUD) has indicated it also will not convert to the USEC. Taking into account the utilities that have converted at less than 100 percent of requirements, approximately 79 percent of US installed capacity is covered by DOE; two percent by Eurodif; one percent by Urenco; and 18 percent is uncommitted. The 18 percent of the US market that is presently uncommitted amounts to approximately seven percent of the world market for enrichment services.

Conclusion

Conversions to the USEC and some penetration of the US market by non-DOE primary suppliers have left DOE with approximately 60 percent of the current worldwide market for enrichment services (Table 1 gives a breakdown). Eurodif holds 20 to 25 percent, Urenco holds 5 to 10 percent, and the USSR holds up to 5 percent. The uncommitted portion amounts to approximately nine percent of the market, almost all in the USA.

In a number of instances involving both Far East and European customers, the announced percentage of requirements to be covered by DOE is misleading. Several utilities for which DOE claims 100-percent coverage have one or more reactors that will, in fact, receive little or no enrichment from DOE. Thus, by defining requirements as relating only to those reactors it now covers, DOE implies a situation quite different from reality. Similar situations exist as a consequence of the various concessions DOE has granted as inducements to maintain market share.

DOE has been careful not to reveal the appendices of signed USECs, even going so far as to refuse Representative Richard Ottinger's (D., N.Y.) request for copies of the contracts. DOE has offered various justifications, such as customers' requests for confidentiality or DOE's desire to avoid giving their foreign competitors any advantage with those customers that have not yet signed. The most important reason, however, is DOE's fear that any customer learning of a concession made by DOE to another customer would insist on reopening negotiations to obtain the same concession(s). Even after DOE's November 17 target date for releasing the data, there is no certainty that DOE will release the appendix details.

Next month's Report will analyze the balance of SWU supply and demand and its effect on the market; that analysis will incorporate Nuexco's knowledge of the terms and conditions that applied to individual customers' conversions to the USEC. It will also incorporate Nuexco's projections of buyers' decisions on alternate SWU supplies, both for the fractions of requirements their current USEC allows to be purchased on the open market and for future years, when they may change the fraction.

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CURRENT MARKET DATA

October 31, 1984	Market Values	Active Supply[1] (thousands)	Active Demand[1] (thousands)
EXCHANGE VALUE	**$16.00**/lb. U_3O_8	5,450	1,275
CONVERSION VALUE	**$1.00**/lb. U in UF_6	1,225	0
SWU VALUES		650	170
DOE origin, 0.3 tails assay			
FY85 delivery	**$115**/SWU		
FY86 delivery	**$20** discount/SWU		
non-DOE origin, delivery within 15 months	**$90**/SWU		
non-DOE origin, CY86 delivery	**$98**/SWU		
LOAN USE CHARGE RATE	**6%**/annum	0	0

	$/lb. U_3O_8	Millions of Pounds	Number of Transactions	Number of Months
TRANSACTION VALUE	**16.05**	2.7	10	5

DEFINITIONS

1. The **Exchange Value** is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the date indicated.
2. The **Conversion Value** is Nuexco's judgment of the price at which spot and near-term transactions for significant quantities of conversion services could be concluded in the secondary market as of the date indicated.
3. The **SWU Values** represent Nuexco's judgment of the price at which transactions for the sale of significant quantities of SWUs of stated origin for delivery in the specified time period could be concluded as of the date indicated.
4. The **Loan Use Charge Rate** is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the date indicated.
5. The **Transaction Value** is a weighted average price of recent natural uranium sales transactions. The calculation is based on prices paid in:
   a. Transactions closed within the previous three-month period for which delivery is scheduled within one year of the transaction date;
   b. At least ten transactions;
   c. Transactions involving a sum total of at least 2 million pounds U_3O_8 equivalent.

   The sample time is extended as necessary to include these minima. Other currencies are converted to US dollars using conversion rates in effect on or near the transaction date.

DERIVATIONS AND COMMENTS

1. All Market Values are based on:
   a. Data from recently completed transactions.
   b. Data from pending transactions.
   c. Firm bids to buy or borrow, and firm offers to sell or lend.
   d. Prices purchasers or rates borrowers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy or borrow, and prices sellers or rates lenders have expressed a willingness to offer, but for which Nuexco is not aware of firm offers to sell or lend.
2. Prices associated with deliveries under old or renegotiated contracts or other than arm's-length transactions are not considered in the determination of these Market Values.
3. In the determination of the Conversion Value, Nuexco does not consider transportation charges other than those customarily provided by primary suppliers of conversion services.
4. The prices of conversion services or SWUs delivered under long-term contracts with primary suppliers are not considered in the determination of either the Conversion Value or SWU Value.
5. For the DOE SWU Values, Nuexco converts SWU prices at varying tails and product assays to equivalent SWU prices at a tails assay of 0.30 weight-percent U_{235} and a product assay of 3.0 weight-percent U_{235}, assuming feed costs corresponding to the Nuexco Exchange and Conversion Values determined as of the same date.
6. In calculating the Transaction Value, Nuexco does not account for the price of uranium delivered in connection with contracts which call for "market price" mechanisms. This exclusion applies particularly to contracts in which delivery prices are expressed as a function of future Exchange Values or any other indeterminant variable. Also excluded from the calculation are any other transactions in which the delivery price is defined in such a way that it cannot currently be determined.

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[1] Supply and demand tables in the *Current Market Data* section of this Report detail the numbers for each category. Quantities of SWUs (Separative Work Units) are not referenced to a particular origin.

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EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

	per lb. U_3O_8 in Concentrates			per kg. U in Concentrates		
Country (currency)	This Month (Oct. 31, 1984)	Last Month (Sept. 30, 1984)	12 Months Ago (Oct. 31, 1983)	This Month (Oct. 31, 1984)	Last Month (Sept. 30, 1984)	12 Months Ago (Oct. 31, 1983)
Australia (dollar)	18.90	20.96	25.60	49.14	54.49	66.55
Belgium (comm. franc)	984.62	1,072	1,228	2,560	2,786	3,192
Canada (dollar)	21.08	23.05	28.96	54.80	59.92	75.29
Finland (markka)	101.59	110.06	132.92	264.10	286.14	345.56
France (franc)	149.39	162.04	187.85	388.39	421.26	488.37
FRG (mark)	48.69	53.05	61.63	126.59	137.91	160.23
Italy (lira)	30,177	32,901	37,480	78,454	85,535	97,440
Japan (yen)	3,927	4,280	5,469	10,210	11,126	14,218
Netherlands (guilder)	54.91	59.50	69.10	142.75	154.70	179.64
South Africa (rand)	30.59	29.17	26.87	79.53	75.83	69.86
Spain (peseta)	2,736	2,959	3,571	7,113	7,693	9,285
Sweden (krona)	139.13	149.83	183.36	361.71	389.52	476.71
Switzerland (franc)	40.06	43.68	50.03	104.15	113.57	130.07
UK (pound)	13.18	14.05	15.71	34.26	36.52	40.84
US (dollar)	16.00	17.50	23.50	41.60	45.50	61.09

TRANSACTION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

	per lb. U_3O_8 in Concentrates			per kg. U in Concentrates		
Country (currency)	This Month (Oct. 31, 1984)	Last Month (Sept. 30, 1984)	12 Months Ago (Oct. 31, 1983)	This Month (Oct. 31, 1984)	Last Month (Sept. 30, 1984)	12 Months Ago (Oct. 31, 1983)
Australia (dollar)	18.96	19.82	25.76	49.29	51.53	66.98
Belgium (comm. franc)	987.69	1,013	1,236	2,568	2,635	3,212
Canada (dollar)	21.14	21.80	29.14	54.97	56.67	75.77
Finland (markka)	101.90	104.09	133.77	264.93	270.61	347.76
France (franc)	149.86	153.24	189.05	389.60	398.39	491.48
FRG (mark)	48.84	50.17	62.02	126.98	130.42	161.25
Italy (lira)	30,272	31,115	37,719	78,699	80,892	98,062
Japan (yen)	3,940	4,047	5,504	10,242	10,522	14,309
Netherlands (guilder)	55.08	56.27	69.54	143.19	146.30	180.78
South Africa (rand)	30.69	27.58	27.04	79.78	71.71	70.31
Spain (peseta)	2,745	2,798	3,594	7,135	7,275	9,344
Sweden (krona)	139.57	141.70	184.54	362.84	368.38	479.75
Switzerland (franc)	40.19	41.31	50.35	104.47	107.40	130.90
UK (pound)	13.22	13.29	15.81	34.37	34.54	41.10
US (dollar)	16.05	16.55	23.65	41.73	43.03	61.48

[1] Calculated using currency exchange rates published in the *Wall Street Journal* on October 31, 1984.

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CURRENT MARKET DATA

CONVERSION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb. U as UF_6			per kg. U as UF_6		
	This Month (Oct. 31, 1984)	Last Month (Sept. 30, 1984)	12 Months Ago (Oct. 31, 1983)	This Month (Oct. 31, 1984)	Last Month (Sept. 30, 1984)	12 Months Ago (Oct. 31, 1983)
Australia (dollar)	1.18	1.20	0.65	2.60	2.64	1.44
Belgium (comm. franc)	61.54	61.24	31.35	135.67	135.00	69.11
Canada (dollar)	1.32	1.32	0.74	2.90	2.90	1.63
Finland (markka)	6.35	6.29	3.39	14.00	13.87	7.48
France (franc)	9.34	9.26	4.80	20.58	20.41	10.57
FRG (mark)	3.04	3.03	1.57	6.71	6.68	3.47
Italy (lira)	1,886	1,880	956.94	4,158	4,145	2,110
Japan (yen)	245.46	244.56	139.63	541.14	539.16	307.84
Netherlands (guilder)	3.43	3.40	1.76	7.57	7.50	3.89
South Africa (rand)	1.91	1.67	0.69	4.22	3.67	1.51
Spain (peseta)	171.00	169.09	91.19	376.99	372.78	201.03
Sweden (krona)	8.70	8.56	4.68	19.17	18.88	10.32
Switzerland (franc)	2.50	2.50	1.28	5.52	5.50	2.82
UK (pound)	0.82	0.80	0.40	1.82	1.77	0.88
US (dollar)	1.00	1.00	0.60	2.20	2.20	1.32

SWU VALUES EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	DOE SWU FY85 (October 31, 1984)	Non-DOE SWU delivery within 15 months (October 31, 1984)	Non-DOE SWU calendar year 1986 (October 31, 1984)
Australia (dollar)	135.85	106.32	115.77
Belgium (comm. franc)	7,077	5,538	6,031
Canada (dollar)	151.50	118.56	129.10
Finland (markka)	730.16	571.43	622.22
France (franc)	1,074	840.34	915.03
FRG (mark)	349.97	273.89	298.23
Italy (lira)	216,899	169,747	184,836
Japan (yen)	28,228	22,091	20,055
Netherlands (guilder)	394.65	308.85	336.31
South Africa (rand)	219.89	172.08	187.38
Spain (peseta)	19,665	15,390	16,758
Sweden (krona)	1,000	782.61	852.17
Switzerland (franc)	287.93	225.34	245.37
UK (pound)	94.73	74.14	80.72
US (dollar)	115.00	90.00	98.00

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[1] Calculated using currency exchange rates published in the *Wall Street Journal* on October 31, 1984.

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RECENT TRANSACTIONS[1], [2]

Uranium Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U_3O_8 equivalent)	Approximate Price as Percent of Current E.V.	Seller	Buyer	Remarks
3173	1984	50-100	104	R[2]	R[2]	UF_6.
3172B	1984	101-300	104	R[2]	R[2]	Contained in LEU.
3167	1984	less than 50	109	US Utility	US Producer	UF_6. Occurred in mid-1984.
3166	1984	101-300	104	US Utility	European Utility	UF_6. Occurred in mid-1984.
3162	1984	50-100	113	US Producer	US Utility	
3161	1984	101-300	113	Canadian Producer	European Utility	Occurred in mid-1984.
3160	1985	50-100	R[2]	R[2]	US Utility	
3153	1984	50-100	102	US Producer	R[2]	
3145	1985	101-300	see remarks	Canadian Producer	US Utility	Price related to market at time of delivery.
3144	1984	301-600	R[2]	Canadian Producer	US Utility	
3136	1984	50-100	98	US Utility	US Utility	UF_6. Assumes .30/lb. U for conversion component.

[1] Transactions listed are not limited to those in which Nuexco was involved, but also include others of which Nuexco is aware.

[2] The notation *R* means that Nuexco either does not know, or that Nuexco has restricted that information to protect client confidentiality.

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CURRENT MARKET DATA

RECENT TRANSACTIONS[1], [6] *(Cont.)*

Enrichment Services
Secondary Market Sales

Nuexco Transaction Number	Delivery Period[2]	Approximate Quantity[3] (thousands of SWUs)	Approximate Price[4] as Percent of Current SWU Value[5]	Seller Group	Buyer Group	SWU Origin	Remarks
3172A	FY85	less than 50	89	R[6]	R[6]	DOE	Contained in LEU.
3164	1985	less than 50	86	US Utility	US Utility	DOE	
3159	FY86	50-100	greater than 86 (see footnote 7)	R[6]	US Utility	DOE	
3142	FY87	101-300	R[6]	European Utility	US Utility	DOE	
3139	FY85	101-300	91	US Utility	US Utility	DOE	
3137	FY85	less than 50	91	US Utility	US Utility	DOE	
3135	FY84	less than 50	indeterminate	US Utility	US Utility	DOE	
3102	FY86	101-300	95	European Utility	US Utility	DOE	See footnote 5.

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[1] Transactions listed are not limited to those in which Nuexco was involved, but also include others of which Nuexco is aware.

[2] Refers to calendar year, not fiscal year.

[3] If tails assay is unknown or unspecified, Nuexco's calculation of SWU quantity assumes 0.20 w/o tails assay.

[4] Price is not normalized to 0.20% tails assay.

[5] Refers to SWU Value that corresponds to SWUs included in transaction. When prices and SWU values are expressed as discounts (e.g., X dollars less than DOE's USEC base price at time of delivery), the percentage refers to the ratio of the *discounts*, not the ratio of the prices.

[6] The notation *R* means that Nuexco either does not know, or that Nuexco has restricted that information to protect client confidentiality.

[7] The discount in this transaction was greater than 86% of the current SWU value for DOE SWUs and FY86 delivery. See footnote 5.

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URANIUM SUPPLY
(October 31, 1984)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Spot or Near-term[2]	 Intermediate or Long-term	Remarks
Available for Sale:			
ACTIVE			
1575	500	500 per year	
1860	400	1,500 per year	
2038	1,000	1,000 per year	UF_6
2288A*	40	—	
2288B*	295	—	UF_6
2389*	200	—	
2392	35	—	UF_6
2484	130	—	
2499	15	—	
2516	200	—	
2538*	35	—	
2574	500	—	UF_6
2588*	100	250 per year	1985-90
2648*	2,000	—	
2134*	—	220 per year	1985-87
2236	—	200 per year	1985-90
2263	—	500 per year	1985-90
TOTAL:	5,450		
INACTIVE			
2191	125	—	UF_6
2275*	150	—	
2335	275	—	
2495	130	—	UF_6
2509*	1,200	1,600	UF_6
2553	300	—	
0564	—	1,000 per year	1985-90
2193	—	800 per year	1986-90
2271	—	500 per year	1984-88
2297	—	200 per year	1986-89
2326	—	1,000 per year	1989-91
2336*	—	250 per year	
2368*	—	250 per year	1987-90
2473	—	500 per year	1984-90
2514	—	1,000 per year	
TOTAL:	2,180		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2429, 2565.

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URANIUM DEMAND
(October 31, 1984)

	Delivery Period[1] (Thousands of Pounds U_3O_8)		
Nuexco Project Number	**Spot or Near-term[2]**	**Intermediate or Long-term**	**Remarks**
Inquiries to Purchase:			
ACTIVE			
2563	800	—	UF_6
2590*	475	—	U_3O_8 or UF_6
2217	—	1,000 per year	1988-95
2442*	—	4,000	1986-95
2507*	—	600	1987-89
2555	—	150 per year	1986-91
TOTAL:	1,275		
INACTIVE			
2329	500	—	1985
2506	50	—	U_3O_8 or UF_6
2532*	70	—	
2576*	20	—	UF_6
1999	—	50 per year	1985-90
2244	—	350 per year	1987 on
2414	—	150 per year	1987-91
2457	—	350 per year	1988 on
TOTAL:	640		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.
Projects removed since last month: 2419, 2528, 2542A.

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CONVERSION SUPPLY AND DEMAND
(October 31, 1984)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U as UF_6)		Remarks
	Within 3 Years	Beyond 3 Years	
Available for Sale:			
ACTIVE			
2141*	1,000	—	
2560	225	—	
TOTAL:	1,225		
INACTIVE			
2051	1,000	—	
2438	500	250	1985-87
2511	600	700	1986-90
TOTAL:	2,100		

*New or revised since last month.
[1] Measured from the date of this Report.
Projects removed since last month: 2420.

No inquiries to purchase conversion this month.

LOAN SUPPLY AND DEMAND
(October 31, 1984)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8)		Remarks
	Within 1 Year	Beyond 1 Year	
Available for Loan:			
INACTIVE			
1938	2,000	—	UF_6
2128	700	—	
2139	2,000	—	
2469A*	800	—	
2483	550	—	
TOTAL:	6,050		

*New or revised since last month.
[1] Measured from the date of this Report.

No inquiries to borrow this month.

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CURRENT MARKET DATA

SWU SUPPLY
(October 31, 1984)

Nuexco Project Number	Delivery Period[1] (Thousands of SWUs) Spot or Near-term[2]	Intermediate or Long-term	Remarks
Available for Sale:			
ACTIVE			
2100*	150	100 per year	
2624*	500	—	
2285*	—	300	
2378*	—	120	1988
2408	—	65	1986
2510*	—	50	
2513*	—	25	1986
2517*	—	150	1986-89
TOTAL:	650		
INACTIVE			
2164*	80	—	
2359	180	—	
2580	150	—	
2583	50	—	
2589*	50	—	
2531	—	150	1987
2571	—	55	1987
TOTAL:	380		

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*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes SWUs deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2192, 2428.

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SWU DEMAND
(October 31, 1984)

Nuexco Project Number	Delivery Period[1] (Thousands of SWUs) Spot or Near-term[2]	Intermediate or Long-term	Remarks
Inquiries to Purchase:			
ACTIVE			
2459*	30	—	
2480	100	—	
2604*	40	—	
2519	—	30 per year	1987 on
2578*	—	150	1986
2688*	—	40	1986
TOTAL:	170		
INACTIVE			
2500*	—	450	1987-90
2512	—	15 per year	1987 on
2543*	—	20	1986
2550*	—	50 per year	1986 on
TOTAL:	0		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes SWUs deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2443, 2452, 2471, 2503, 2552, 2562, 2564, 2579.

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OPTIMUM TAILS ASSAY—Part 1

Introduction

An often-neglected variable in nuclear fuel management is the tails assay, the concentration of U_{235} in the waste stream of the enrichment process. The choice of tails assay can vary the cost of fuel by more than ten percent, but the selection of an optimum tails assay is not intuitively obvious; methods which worked in the past do not always apply to today's markets.

This is the first in a series of three articles on enriched uranium and the optimum tails assay. The first article covers the theory and economics of the enrichment process, how the cost of enriched uranium depends on the tails assay, and how to find the tails assay which gives the minimum product cost. The second installment will show how the tails assay for minimum cost changes for SWU prices that vary with tails assay, including the effects of the variable tails assay option (VTAO) surcharge and secondary SWU market transactions. The final essay will consider the optimum tails assay for utilities having feed in inventory which was purchased at relatively high prices, a question which confronts many utility fuel managers today.

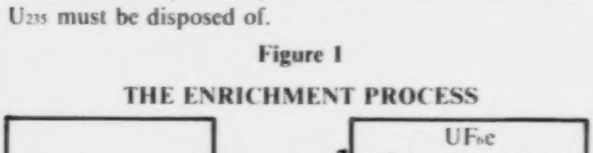
The Enrichment Process

Uranium neither depleted nor enriched in U_{235} is called natural uranium. The naturally occurring concentration (or assay) is 0.711 percent U_{235} by weight (w/o); an assay higher than that of natural uranium is also referred to as the enrichment level.

Most commercial applications of uranium require concentrations (enrichments) of 2 to 4 w/o in U_{235}. To increase the U_{235} assay of uranium (to enrich it), the uranium (feed material) is passed through a process which physically separates the U_{235} atoms from the more prevalent (and slightly heavier) U_{238} atoms. The enrichment process is not 100-percent efficient and eventually some waste material (the tails) with a small concentration of U_{235} must be disposed of.

Figure 1

THE ENRICHMENT PROCESS



The current diffusion and centrifuge enrichment processes use as feed material uranium in a gaseous form, uranium hexafluoride (UF_6). These processes are shown in schematic form in Figure 1.

The conservation of mass in the enrichment process is governed by the equation:

$$UF_6n = UF_6t + UF_6e$$

where UF_6n is the feed material, UF_6t is the tails stream, and UF_6e is the enriched product. The *Feed Factor*, or the quantity of feed required to obtain a unit quantity of enriched product is:

$$\frac{\text{Feed}}{\text{Product}} = \frac{[p - t]}{[f - t].}$$

where f, p, and t are the assays of the product, feed, and tails stream. (See Appendix for derivation.)

For a given quantity of enriched product, the quantity of feed material varies with both product and tails assay. Figure 2 shows how feed material quantity is related to product assay in the enrichment process, while Figure 3 shows its relationship to tails assay. As the tails assay is increased, the quantity of feed material required increases, becoming infinitely large as the tails assay approaches the feed material assay.

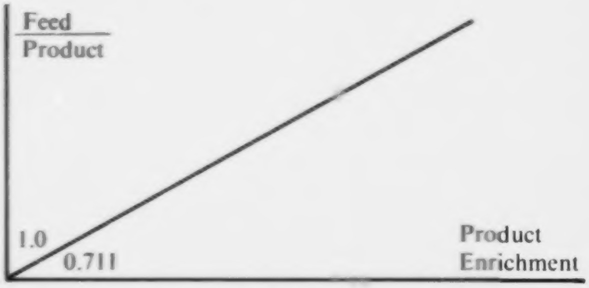


Figure 2. Quantity of Feed Material Required as a Function of Final Product Enrichment for a Fixed Tails Assay.

The enrichment process uses energy measured in Separative Work Units or SWUs. The number of SWUs required to obtain enriched product is a more complex function, because the separation process becomes more difficult as the separation between the product and waste stream increases (as the product enrichment increases or the tails assay decreases). The common units used for ura-

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nium hexafluoride feed and product material are kilograms of uranium (all isotopes), or KgU. In keeping with the units for the UF_6 product, the unit commonly used for SWUs is kilograms, sometimes referred to as Kg-SWU.

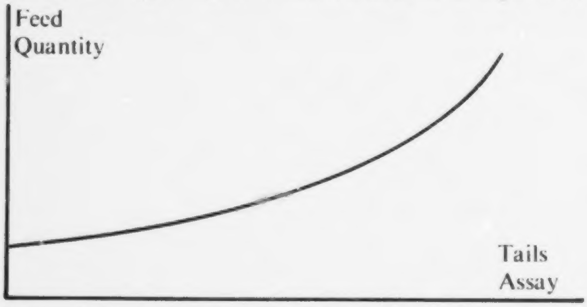

Figure 3. Feed Material Required as a Function of Tails Assays for a Fixed Quantity of Final Product at a Given Enrichment.

The required number of SWUs per KgU of product, or *SWU Factor*, is obtained by:

$$\text{SWU Factor} = V(p) - V(t) - \text{Feed Factor} \times [V(f) - V(t)],$$

where V is the function:

$$V(y) = (2y - 1) \times \mathrm{Ln}[y/(1 - y)],$$

and f, p, and t are the assays of the feed, product, and tails streams.

The relationships of the required SWUs to product and tails assays are shown in Figures 4 and 5. The quantity of SWUs required is a non-linear function of the product enrichment, starting at zero for product enrichments of 0.711 w/o. The required quantity of SWUs declines as the tails assay is increased, but does not approach zero.

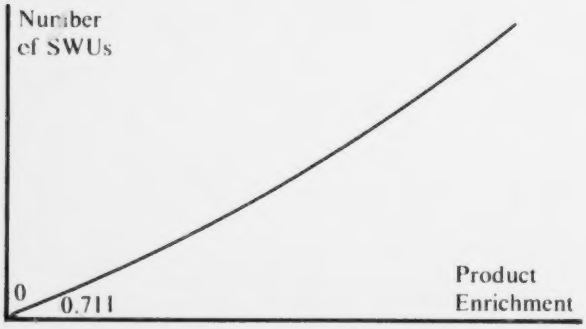

Figure 4. Number of SWUs Required as a Function of Product Enrichment for a Fixed Tails (Waste) Assay.

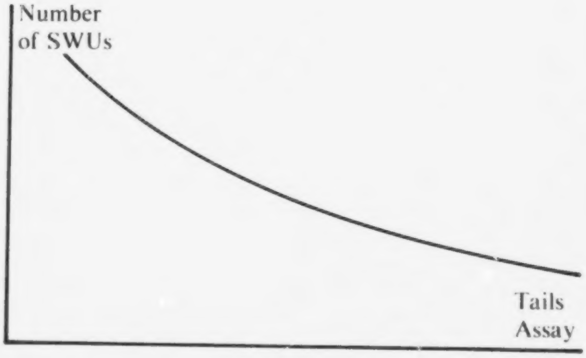

Figure 5. Number of SWUs Required as a Function of Tails Assay for a Fixed Quantity of Final Product at a Given Enrichment.

Product Cost

As seen from the foregoing relationship, a given quantity of enriched product at a given assay (concentration of U_{235}) may require a different quantity of feed material and a different number of applied SWUs, depending on the tails assay (concentration of U_{235} in the waste material) used. As a result, the unit cost (cost per KgU) of the enriched product, which is the sum of the cost of feed material and cost of applied SWUs, varies with the tails assay.

$$\text{Product Cost} = \text{Feed Cost} + \text{SWU Cost}$$

$$\text{or} \quad = \begin{bmatrix} \text{Feed Factor} \\ \times \\ \text{Feed Unit Cost} \end{bmatrix} + \begin{bmatrix} \text{SWU Factor} \\ \times \\ \text{SWU Unit Cost.} \end{bmatrix}$$

At this point, the reader may be wondering why there is all this concern over the tails assay. After all, the tails assay is fixed at the enrichment plant, and it probably cannot be changed at the whim of every fuel manager. In reality, this is true for the *physical* tails assay, but there also can be a *transaction* tails assay other than the physical one.

All enrichment transactions, including those with the primary enrichment suppliers, actually exchange *feed material plus money* for *enriched product.* If the seller of enrichment services wants to sell the enriched product at a transaction tails assay different from the one at which it was produced or otherwise acquired, he will get more feed and less money in return at higher transaction tails, or vice versa at lower tails. Once the *transaction tails* is

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established, the amount of money and feed are determined by the price of the SWU and the theoretical Feed Factor and SWU Factor relationships given earlier.

For example, at times the USDOE has used a physical tails assay higher than its average transaction tails assay. This allowed the DOE to produce more enriched product per SWU from its enrichment plants at a time when it was concerned about having enough capacity. Operating at a higher tails assay required more feed material than DOE's customers were obliged to provide, so DOE furnished the difference from its own feed stockpile.

Optimum Tails Assay

Given that the tails assay is a variable, the important question is "which tails assay is best?". Past economic analyses of the enrichment process have focused on finding the tails assay that allows the minimum product cost, and usually have assumed that the unit feed and SWU costs are constants. With these assumptions, there are well-known techniques to evaluate the sensitivity of product cost to tails assay and to find a tails assay which yields the minimum product cost. Figure 6 shows the cost of UF_6 product enriched to 3.5 percent U_{235}, as a function of tails assay, for typical feed and enrichment costs of $50/KgU and $135/SWU.

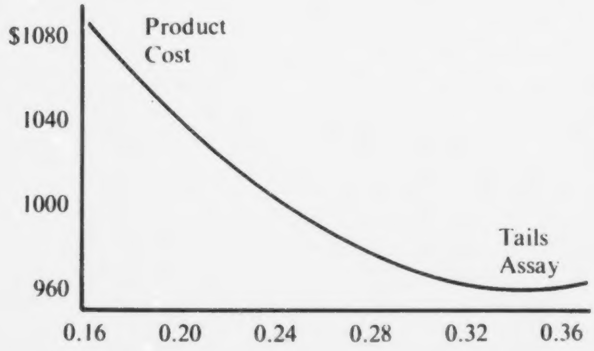

Figure 6. Cost of 3.50 w/o Product as a Function of Tails Assay for $50/KgU Feed and $135 SWU (Feed/SWU ratio = 0.37).

For the assumptions used in Figure 6, the product cost varies by about 15 percent in the range of tails assays available today, reaching a minimum at about 0.33 w/o. The tails assay for minimum product cost (using natural feed) is only dependent on the ratio of feed material unit cost to SWU cost. (It is not dependent on the enrichment level of the product.)

A method for finding the tails assay for minimum product cost is given in the Appendix. This tails assay is shown in Figure 7 as a function of the feed/SWU cost ratio. As expected, if the unit cost of feed rises in relation to the cost of a SWU, the minimum product cost is achieved by using a lower tails assay (less feed and more SWU).

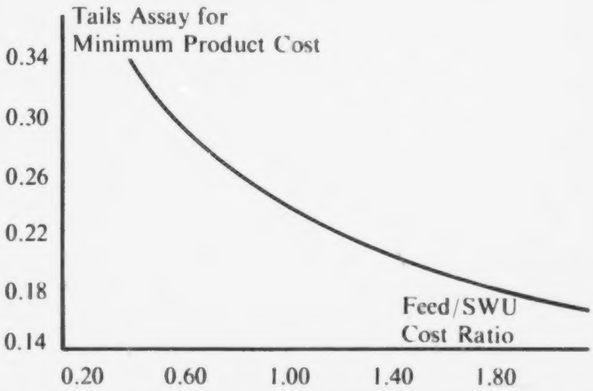

Figure 7. Tails Assay for Minimum Product Cost as a Function of the Feed/SWU Cost Ratio for Natural Uranium Feed.

Limitations

In the past, it was a commonly accepted principle that the tails assay shown in Figure 7 was the *optimum tails assay*. However, it is important to realize that the correct definition is *the tails assay for minimum product cost, assuming constant unit feed and SWU costs.* In the real world of uranium procurement, the assumptions used in deriving Figure 7 are usually not valid, and the minimum product cost may not always be the desired goal.

The true optimum tails assay is a function of the unique opportunities, constraints, and goals of individual utilities, and it is no longer intuitively obvious where the true optimum lies. The next essay in this series will discuss the ways in which variable unit SWU costs can affect the tails assay for minimum product cost, such as the VTAO surcharge and de-enrichment swap transactions. The final installment will show that the optimum tails assay is not necessarily that which gives the minimum product cost for a single batch of fuel. The immediate savings on one batch of enriched product may turn into added costs on subsequent future deliveries, thereby increasing overall costs. It also will discuss the optimum tails assay for other fuel management goals.

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APPENDIX

Derivation of the Feed Factor

The quantity of feed required to obtain enriched product is obtained from the equations of conservation for uranium and for U_{235} atoms:

$$\text{Feed (KgU)} = \text{Tails (KgU)} + \text{Product (KgU)}$$

and

$$U_{235}\text{ (feed)} = U_{235}\text{ (tails)} + U_{235}\text{ (product)}.$$

Expressing the number of U_{235} atoms as the weight of material times the weight-concentration of U_{235} (assay), the second equation becomes:

$$\text{Feed (KgU)} \times f = \text{Tails (KgU)} \times t + \text{Product (KgU)} \times p,$$

where f, p, and t are the assays of the feed, product, and tails (waste) streams.

Using the first conservation equation to express the quantity of tails material gives:

$$\text{Feed (KgU)} \times f = [\text{Feed (KgU)} - \text{Product (KgU)}] \times t + \text{Product (KgU)} \times p.$$

Solving for the quantity of feed per unit of enriched product:

$$\frac{\text{Feed (KgU)}}{\text{Product (KgU)}} = \frac{[p - t]}{[f - t]}$$

Tails Assay for Minimum Product Cost

The unit cost of enriched uranium is expressed as:

$$\text{Product Cost} = \text{Feed Factor} \times \text{Unit Feed Cost} + \text{SWU Factor} \times \text{Unit SWU Cost}.$$

The tails assay for the minimum product cost is found by taking the differential (slope) of this function with respect to the tails assay and setting it equal to zero. The resulting expression can be put to practical use in two ways. First, the equation can be solved explicitly for the feed/SWU cost ratio as a function of the optimum tails:

$$\text{Feed/SWU Cost} = V(f) - V(t) - C \times (f - t),$$

where

$$C = (2t - 1)/[t(1 - t)] + 2\text{Ln}[t/(1 - t)]$$

This equation can be graphed, and the graph used to find the inverse relationship.

As an alternative to the graphical solution, the following series of implicit equations can be solved by iteration on a computer or programmable calculator. In this series of equations, the feed is assumed to be 0.711 w/o, and the assays are also in units of weight-percent, in contrast to the other equations in this appendix, which use assay as weight fractions (weight-percent = weight fraction × 100).

$$A = (\text{Tails\%}/50 - 1) \times (0.711 - \text{Tails\%})$$

$$B = 4.868883 - (\text{Feed/SWU Cost}) + 0.985780 \times \text{Ln}\,[(\text{Tails\%}/(100 - \text{Tails\%})]$$

$$\text{Tails\%} = A \times 100/[(100 - \text{Tails\%}) \times B].$$

If the iteration is started with a tails assay of 0.20 w/o, the results are quite accurate within 5 iterations.

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AUSTRALIA

The Australian government has agreed to buy 1,600,000 pounds U_3O_8 from Queensland Mines Ltd. (QML) over the next two years. The concentrates are part of a QML contract to supply 5,200,000 pounds U_3O_8 to Electricite de France (EDF). The material cannot be delivered because of the Australian government's ban on uranium shipments to France as long as it continues to conduct nuclear weapons testing in the South Pacific.

The government agreed to purchase each of the next eight shipments at the original delivery price. Based on the Australian floor price of approximately $31, QML's compensation would approach US$50,000,000 over the next two years. The agreement requires the company to repay the government if it sells the material to another buyer. The quarterly shipments purchased by the government will run through September 1986 and will increase the Australian government's stockpile by 30 percent, to more than 5,000,000 pounds U_3O_8.

The purchase relieves the Australian Labor Party (ALP) of pressure from the uranium producers for the time being, until new arrangements can be made concerning Australia's uranium exporting policies. The next ALP policy conference is scheduled for mid-1986. Limiting the compensation agreement to two years implies that some strategists hope for a relaxation of the ban at the 1986 conference. The ban might be lifted by then, or the French might have discontinued weapons testing. However, a total of about 3,200,000 pounds U_3O_8 remains to be delivered, so unless the situation changes by then, the government could come under renewed pressure to make a second purchase equal to the first, thereby accounting for the entire undelivered supply.

Electricite de France has made no comment on the deal. In September, EDF agreed to suspend the contract with QML. Without EDF's consent, QML would have had to declare force majeure or become liable for breach of contract. There is sufficient uranium on the spot market, at lower prices, to cover EDF's present needs, and it appears that France would like to maintain good relations with a major supplier.

* * *

Energy Resources of Australia's ownership changed when North Broken Hill Holdings, Ltd. replaced one of ERA's original shareholders, EZ Industries (31 percent) in a successful takeover. Other ownership percentages were not affected. The current ownership structure of ERA is shown in Table 2.

Table 2

ENERGY RESOURCES OF AUSTRALIA OWNERSHIP

Company	Percent Share
North Broken Hill Holdings, Ltd.[1]	30.96
PEKO-Wallsend Operations, Ltd.	30.96
Australian public	13.08
Japan Australia Uranium Resources Development Company, Ltd.	10.00
Rheinische Braunkohlenwerke AG[2]	6.25
Urangesellschaft Australia Pty. Ltd.	4.00
Badenwerke AG	2.50
Saarberg-Interplan Uran	1.25
Oskarshamnverkets Kraftgrupp AG (OKG)	1.00
	100.00

[1] Acquired Electrolytic Zinc Company of Australasia, Ltd.

[2] A subsidiary of Rheinisch-Westfaelisches Elektreizitaetswerk AG (RWE).

* * *

The feasibility study for the development of the Olympic Dam project (Roxby Downs) undertaken jointly by Western Mining (WMC) and BP Australia will cost A$150 million, with an expenditure to date of A$71.5 million. The joint venture partners have struck a new arrangement for the funding of the study. Western Mining will fund 51 percent of the future expenditure, while BP will pay for the expenditure to date plus 49 percent of the remainder. WMC's contribution amounts to A$40 million.

The joint venture partners have been issued determinations under the government floor price system. These allow them individually to enter into negotiations with potential customers. When applying for determinations, companies submit both the names of potential customers and approximate quantities, which become the basis for government approval.

The project is likely to proceed in stages, depending on feasibility and market conditions. To make it viable, uranium sales of 2.5 million pounds per year would be needed

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initially, in addition to an adequate market niche for the copper production. The partners, even in the face of a gloomy market outlook, are still hopeful of launching the project in the 1980s.

SOUTH AFRICA

Third-quarter production from Chamber of Mines producers amounted to approximately 3,500,000 pounds U_3O_8, down slightly from the level of 3,800,000 pounds produced in the second quarter of 1984 and the level of 3,850,000 pounds produced in the first quarter of the year (Table 3). The 7-3-percent decline from the second quarter production can be attributed to the following factors:

1. The cessation of mining operations and the completion of underground reclamation at the Beisa (St. Helena) operation caused a 68-percent drop in production.
2. A 14-percent drop in tons of ore treated at the Dreifontein Consolidated operation resulted in a 15-percent drop in production there.
3. Lower uranium ore grades accounted for a 24-percent drop in production at East Rand Gold and Uranium Co. Ltd. (ERGO).

These losses were partially offset by normal fluctuations in tons of ore treated, and several operations reported small gains in production. JMS (Free State Joint Metallurgical Scheme) reported an increase in production of 10 percent, and Harmony reported a 5-percent increase. Despite that small increase, Harmony is slowing its U_3O_8 production because of the company's view of a heavily overstocked market. To avoid the buildup of excessive stockpiles, Harmony reduced the amount of slimes processed for uranium recovery to 6.65 million metric tons from 7.29 million metric tons.

Due to the conclusion of mining operations at the Beisa operation, and the slowdown of Harmony production, Nuexco's forecast of 1984 output from Chamber of Mines producers amounts to approximately 14,500,000 pounds U_3O_8.

* * *

Table 3

REPUBLIC OF SOUTH AFRICA: 1984 URANIUM PRODUCTION[1]
(Thousands of pounds U_3O_8)

Operation	First Quarter 1984	Second Quarter 1984	Third Quarter 1984	Year to Date
Beisa (St. Helena)[2]	338	333	107	778
Blyvooruitzicht	155	132	142	429
Buffelsfontein	313	331	337	981
Chemwes (Stilfontein)	310	279	290	879
Dreifontein Consolidated	98	104	88	290
ERGO[3]	113	94	71	278
Harmony	307	259	274	840
Hartebeestfontein	248	253	225	726
JMS[4]	356	265	293	914
Randfontein	287	361	361	1,009
Vaal Reefs	1,069	1,129	1,078	3,276
Western Areas	175	171	164	510
Western Deep Levels	79	82	83	244
TOTAL	3,848	3,793	3,513	11,154

---

[1] Excludes Palabora Mining Company, which is not a member of the Chamber of Mines.
[2] Mining operations ceased and underground reclamation completed.
[3] ERGO = East Rand Gold and Uranium Co. Ltd.
[4] JMS = Free State Joint Metallurgical Scheme.

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Palabora Mining Company reported sales of about 502,000 pounds U_3O_8 during the first six months of 1984. That figure represents a 29-percent increase over the 356,000 pounds U_3O_8 sold in the first half of 1983. The company has no further uranium concentrate sales scheduled for the remainder of 1984.

UNITED STATES

The Energy Information Administration (EIA) has released information on uranium production and resources in the USA in 1983. Production of uranium concentrates fell 21 percent in 1983 to 21.2 million pounds, down from 26.9 million pounds in 1982. Before processing, with the usual recovery loss of about five percent, uranium contained in mined ore totalled 23.5 million pounds in 1983, a 12-percent decline as compared to 26.8 million pounds in 1982. Of the 23.5 million pounds extracted in 1983, 18.6 million pounds (79 percent) were contained in uranium-bearing ore mined by conventional (open-pit and underground) mining methods. The average grade was 0.126 percent. The remainder was extracted from mine dumps, mill tailings, heap leaching, in-situ leaching, mine water, and as a byproduct of phosphate and copper mining. More than half of the uranium extracted came from Wyoming and New Mexico.

The EIA also reported estimates for reasonably assured resources (RAR) and estimated additional resources (EAR) for the USA. The three categories for RAR (Lower, Medium and Higher Cost) contain an estimated total of 1.79 billion pounds of RAR (Table 4).

Nuexco production forecasts for 1983 anticipated a decline in production to 20.6 million pounds U_3O_8 (Report 186), 600,000 pounds less than the EIA figure. Expecting that decline to continue, Nuexco's current forecast of uranium production anticipates US output to amount to approximately 16,000,000 pounds U_3O_8 in 1984.

CORRECTION

In the Annual Update on Taiwan in Report 193 (September 1984), Nuexco reported that Taipower receives its uranium supply from African, Australian, and US producers. In actuality, only African and US producers supply Taipower's uranium requirements. Because the Australian government does not recognize Taiwan, and no bilateral safeguards agreement exists between the two countries, no Australian producer would be able to obtain approval to supply Taiwan under current conditions.

Table 4

US URANIUM REASONABLY ASSURED RESOURCES (RAR)
(On December 31, 1983)[1]

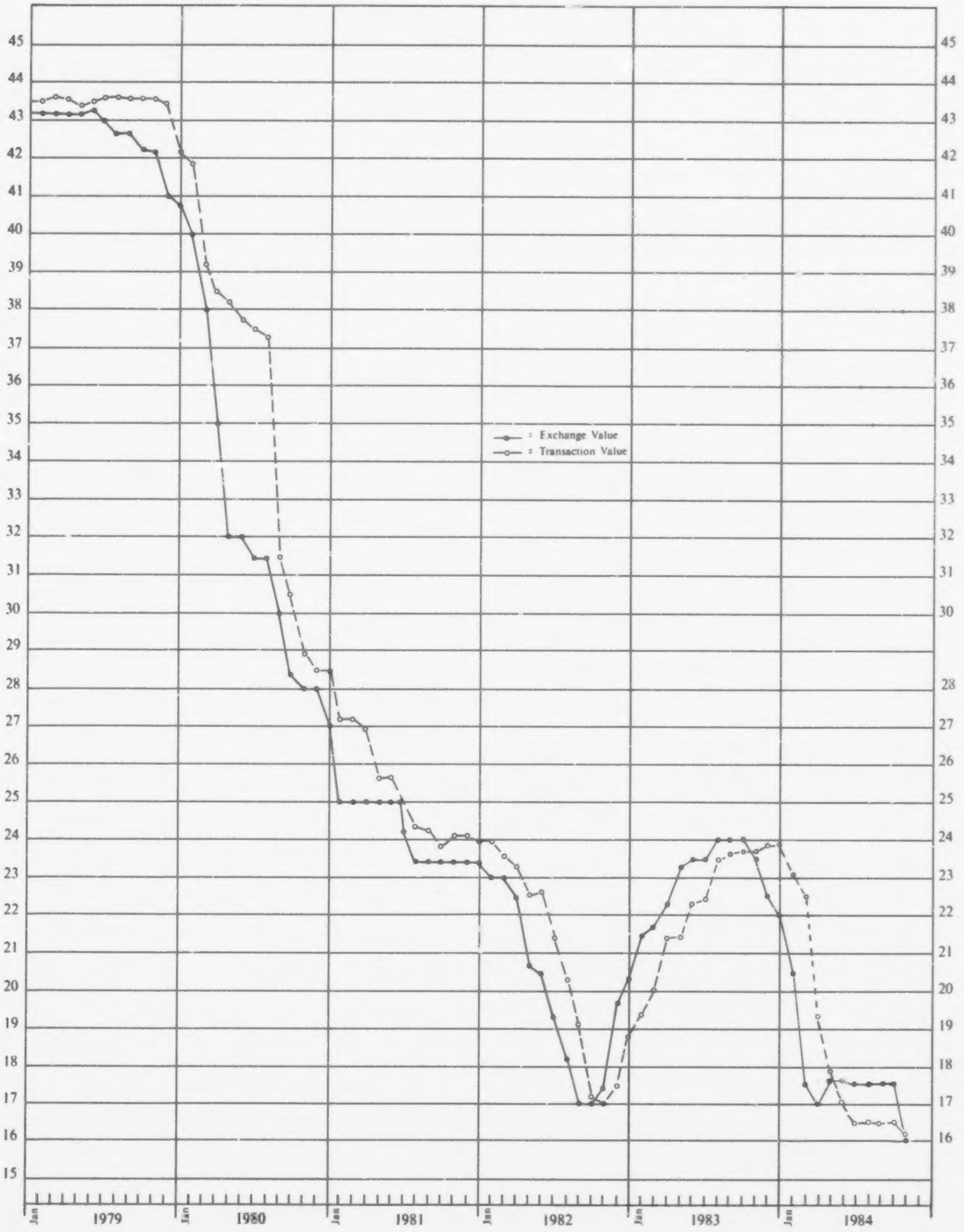
Forward Cost Category	Tons of Ore (millions)	Average Grade (percent U_3O_8)	Contained U_3O_8 (million pounds)
Lower (less than \$30/lb. U_3O_8)	86	0.21	360
Medium (\$30-\$50/lb. U_3O_8)	492	0.08	780
Higher (\$50-\$100/lb. U_3O_8)	819	0.04	630

[1] Source: US Department of Energy, Grand Junction Area Office.

HISTORICAL MARKET DATA

EXCHANGE AND TRANSACTION VALUES SINCE JANUARY 1979

Determined as of the last day of the month indicated



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HISTORICAL MARKET DATA

HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	—	—	—	—	—	—	—	6.35	6.35	6.40	6.45	6.50
1969	—	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	32.50	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00
1981	25.00	25.00	25.00	25.00	25.00	24.25	23.50	23.50	23.50	23.50	23.50	23.50
1982	23.00	23.00	22.50	20.75	20.50	19.25	18.25	17.00	17.00	17.50	19.75	20.25
1983	21.50	21.75	22.25	23.25	23.50	23.50	24.00	24.00	24.00	23.50	22.50	22.00
1984	20.50	17.50	17.00	17.75	17.75	17.50	17.50	17.50	17.50	**16.00**		

HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	—	—	—	—	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38.40	37.90	37.60	37.30	31.60	30.60	29.00	28.70	27.70
1981	27.20	27.20	27.00	25.70	25.70	24.50	24.40	24.30	23.90	24.10	24.10	24.00
1982	24.00	23.70	23.40	22.60	22.70	21.50	20.30	19.10	17.30	17.00	17.55	18.80
1983	19.35	20.00	21.35	21.40	22.35	22.45	23.50	23.60	23.65	23.65	23.85	23.85
1984	23.05	22.50	19.25	17.90	17.00	16.50	16.60	16.40	16.55	**16.05**		

HISTORICAL CONVERSION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U as UF_6)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	1.20	1.20	1.20	1.40	1.15	1.15	1.15	1.10	1.10	1.10	1.20	1.20
1982	1.20	1.20	1.20	1.20	1.00	1.00	1.00	0.90	1.10	1.60	1.45	1.45
1983	1.20	1.40	1.40	1.20	1.20	1.20	1.10	1.10	1.00	0.60	0.60	0.60
1984	0.60	0.30	0.80	0.80	0.80	0.00	0.00	0.80	1.00	**1.00**		

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AUSTRALIA

	Price Index of Materials Used in Manufacturing Industry—All Groups[1] (1969=100)	Award Rates of Pay Indexes Australia—Adult Males In Mining Wage and Salary Earners, Weekly Rates[2] (1976=100)
1983 Avg.	401.2	181.8
Jul 1983	408.3	180.7
Aug 1983	403.0	180.7
Sep 1983	402.9	180.6
Oct 1983	397.5	188.3
Nov 1983	395.5	188.3
Dec 1983	399.2	188.1
Jan 1984	399.1	188.3
Feb 1984	402.4	188.2
Mar 1984	403.8	188.0
Apr 1984	404.1	195.8
May 1984	403.7	196.6
Jun 1984	404.8	196.6
Jul 1984	408.3	196.6
Aug 1984	408.3	196.6

P = Preliminary R = Revised since last month

CANADA

		Wage-earner Data: Average Hourly Earnings (C$)[2]					
	Industry Selling Price Index: Manufacturing[1] (1971=100)	Uranium Mines (SIC 057)	Metal Mines* (SIC 051-059)	Mines, Quarries and Oil Wells[3] (SIC 051-099)	Primary Metal Industries Non-ferrous[4] (SIC 296)	Primary Metal Industries Non-ferrous[4] (SIC 298)	Chemicals and Chemical Products[5] (SIC 372-379)
1983 Avg.	298.8	—	—**	14.30	—	—	11.17
Aug 1983	301.3	16.93	14.36	13.89	11.82	10.08	11.19
Sep 1983	301.1	17.66	14.90	14.41	11.99	10.32	11.29
Oct 1983	301.6	17.73	15.27	14.65	11.76	10.03	11.30
Nov 1983	301.8	17.82	15.29	14.67	11.78	10.62	11.38
Dec 1983	302.9	17.84	15.11	14.66	11.86	10.60	11.51
Jan 1984	305.4	17.74	15.27	14.74	11.91	10.84	11.69
Feb 1984	306.6	17.78	15.59	14.90	12.04	10.82	11.51
Mar 1984	308.7	18.05	15.52	14.82	12.14	10.84	11.58
Apr 1984	310.5	18.06	15.83	15.10	11.96	10.34	11.63
May 1984	310.6	18.48	15.64	15.06	12.11	10.16	11.65
Jun 1984	311.0	18.08	15.48	14.80	12.38	10.40	11.66
Jul 1984	312.6R	17.81R	15.72R	14.92R	12.53R	10.18	11.82R
Aug 1984	312.5R	17.24P	15.44P	14.86P	12.31P	10.31P	11.87P
Sep 1984	312.0P	—	—	—	—	—	—

P = Preliminary R = Revised since last month

For annual averages prior to 1983, and for notes pertaining to these statistics, see pages 23-26 of Report 190 of June 1984.

*The 1980 average for Metal Mines was incorrectly reported as 10.59. The correct average is 10.58 (see Report 190).

**Two different methods were used in the 1983 "Metal Mines" category in reporting survey data, and Statistics Canada did not publish a 1983 average. The March 1983 figure for the old method was 14.73 and for the new method was 14.84. The published average for 1983 in Report 190 was a Nuexco calculation based on the available monthly statistics for 1983 with the exception of the March figure, where only the 14.84 value was taken into account.

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GOVERNMENT STATISTICS

REPUBLIC OF SOUTH AFRICA

	Average Declared Working Costs per per Metric Ton of Gold Ore Milled (Rand)[1]	Tonnage-Weighted Index of Average Working Costs per Metric Ton of Gold Ore Milled (March 1982=100)[2]	Consumer Price Index[3] (1975=100)[4]	Producer Price Index All Groups[5] (1975=100)	Total Employment in Mining and Quarrying (Code 35)[6]	Total Salaries and Wages in Mining and Quarrying (1,000 Rand) (Code 40)[6]
1983 Avg.	51.87	115.0	262.2	274.8	696,579	3,644,772
Aug 1983	—	—	265.6	278.9	698,984	311,789
Sep 1983	52.92	117.4	267.3	279.4	696,435	312,264
Oct 1983	—	—	270.0	281.0	693,225	311,418
Nov 1983	—	—	271.4	281.6	688,459	317,485
Dec 1983	53.70	119.6	273.2	283.7	690,750	333,595
Jan 1984	—	—	274.7	283.3	689,807	326,619
Feb 1984	—	—	278.4	286.5	702,553	335,906
Mar 1984	55.30	123.1	281.9	288.0	715,628	342,332
Apr 1984	—	—	286.1	290.2	712,963	327,550
May 1984	—	—	288.3	292.6	710,040	327,937
Jun 1984	56.95	126.2	291.2	295.3	717,009	347,121
Jul 1984	—	—	295.1	296.0	717,121	369,964
Aug 1984	—	—	297.0	300.8	—	—
Sep 1984	—	—	299.9	—	—	—

UNITED STATES

	Producer Price Index[1]		Consumer Price Index[2]	GNP Implicit Price Deflator[3]	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[4]			
	Industrial Commodities (1967=100)	All Commodities (1967=100)	(1967=100)	(1972=100)	Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)	Electric and Electronic Equipment (SIC 36)
1983 Avg.	315.8	303.1	298.4	215.63	12.57	13.43	10.59	8.65
Aug 1983	317.3	304.7	300.3	—	12.54	13.46	10.62	8.62
Sep 1983	317.1	305.3	301.8	216.44	12.62	13.46	10.70	8.73
Oct 1983	318.5	306.0	302.6	—	12.67	13.55	10.79	8.71
Nov 1983	318.3	305.5	303.1	—	12.64	13.56	10.86	8.77
Dec 1983	318.4	306.1	303.5	218.53	12.75	13.33	10.90	8.84
Jan 1984	319.1	308.0	305.2	—	12.67	13.38	10.91	8.88
Feb 1984	320.6	308.9	306.6	—	12.81	13.34	10.90	8.86
Mar 1984	321.9	311.0	307.3	220.58	12.85	13.33	10.95	8.88
Apr 1984	322.5	311.4	308.8	—	12.91	13.30	10.97	8.89
May 1984	323.3	311.7	309.7	—	12.99	13.37	11.02	8.89
Jun 1984	323.9	311.4	310.7	222.40	12.96	13.40	11.03	8.91
Jul 1984	324.0	312.0	311.7	—	13.02R	13.36	11.12R	8.95
Aug 1984	323.5	310.9	313.0	—	13.07P	13.52P	11.12R	9.00R
Sep 1984	322.3	309.5	314.5	224.36	—	—	11.19P	9.08P

P = Preliminary R = Revised since last month

For annual averages prior to 1983, and for notes pertaining to these statistics, see pages 23-26 of Report 190 of June 1984.

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NUEXCO

EXECUTIVE SUMMARY
REPORT 195
(All data as of October 31, 1984)

Exchange Value
$16.00, down $1.50

The **Exchange Value** is **$16.00** per pound U_3O_8, down $1.50 since last month. Eleven recent uranium sales are reported, involving a total of 1.6 million pounds U_3O_8 equivalent. Four were sales of natural UF_6; all involved deliveries prior to 1986, and five met the conditions for inclusion in the Transaction Value.

Supply-Demand Ratio
fell to 4.3:1

Active spot and near-term **uranium supply** amounts to **5.5 million** pounds U_3O_8 equivalent, down 40 thousand pounds since last month. Active spot and near-term **uranium demand** totals **1.3 million** pounds, up 320 thousand pounds. The spot and near-term **supply-demand ratio** fell to **4.3:1.**

Transaction Value
fell $0.50, to $16.05

The **Transaction Value** is **$16.05** per pound U_3O_8, down $0.50 since last month. The calculation includes 10 transactions involving a total of 2.7 million pounds U_3O_8 and equivalent UF_6, and covers a period of 5 months.

Loan Use Charge Rate
unchanged at 6%

The **Loan Use Charge Rate** remains **6 percent** per annum in a dormant market.

Conversion Value
unchanged at $1.00

The **Conversion Value** is **$1.00** per pound U as UF_6, unchanged since last month. No secondary market conversion transactions are reported. Active secondary market supply of conversion services for delivery within three years totals 1.2 million pounds U as UF_6. No active demand is reported.

SWU Values Unchanged:
$115 for DOE-origin (FY85)
$20 discount for FY86
$90 for non-DOE origin
(delivery within 15 months)
$98 for calendar year 1986

The **SWU Values** are **$115** per SWU of DOE origin and FY85 delivery, at .3 tails, and **$20** per SWU discount from DOE base price for FY86 delivery (at .3 tails). SWU Values for non-DOE origin are **$90** per SWU for delivery within 15 months, and **$98** per SWU for calendar year 1986. Eight secondary market SWU transactions are reported, involving 620 thousand SWUs. Active secondary market SWU supply amounts to 650 thousand SWUs, while active demand totals 170 thousand SWUs. This month's Report reviews the status of enrichment services coverage throughout the world.

Analysis & Commentary

The first in a series of three articles on the concepts and applications of the optimum tails assay demonstrates that standard analytical techniques often fail to reflect current market conditions.

Australia

The Australian government has agreed to buy 1.6 million pounds U_3O_8 from Queensland Mines (QML) over the next two years. The government ban on uranium sales to France blocked scheduled QML shipments to EDF.

South Africa

Third quarter Chamber of Mines uranium production of 3.5 million pounds U_3O_8 was down slightly from the previous quarter.

United States

The Energy Information Administration recently released information on uranium reserves and 1983 production in the USA.

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NUEXCO REPORT 195 FIGURES OF THE MONTH (October 31, 1984)	This Month (Report 195)	Last Month (Report 194)	12 Months Ago (Report 183)
Exchange Value[1]	16.00	17.50	23.50
Transaction Value[1]	16.05	16.55	23.65
Loan Use Charge Rate[2]	6%	6%	6%
Conversion Value[3]	1.00	1.00	0.60
Near-Term Uranium Supply[4]	5.5	5.5	5.9
Near-Term Uranium Demand[5]	1.3	0.96	3.1
Near-Term Supply-Demand Ratio	4.3	5.8	1.9
Recent Uranium Sales:			
Number of Transactions[6]	11	4	3
Quantity of Material[7]	1.6	2.0	0.1-0.3
Nuexco SWU Values:[8]			
DOE origin, FY85 delivery, 0.3 tails assay	115	115	—
DOE origin, FY86 delivery, 0.3 tails assay	20[9]	20[9]	—
non-DOE origin, delivery within 15 months	90	90	—
non-DOE origin, delivery for calendar year 1986	98	98	—
USDOE SWU Prices:			
USEC	135.00	135.00	—
AFC	153.00[10]	153.00[10]	138.65
Requirements	157.00[10]	157.00[10]	149.85
Market Value of Enriched UF_6[11] [12]:			
2.5 w/o U_{235}	528	549[13]	654
3.0 w/o U_{235}	683	709[13]	839
3.5 w/o U_{235}	842	872[13]	1,028
4.0 w/o U_{235}	1,003	1,038[13]	1,219

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[1] US $ per pound U_3O_8 equivalent.

[2] Per annum.

[3] US $ per pound U as UF_6.

[4] Active inquiries to sell, for delivery within 12 months after contract signing (millions of pounds U_3O_8).

[5] Active inquiries to purchase, for delivery within 12 months after contract signing (millions of pounds U_3O_8).

[6] Uranium sales only; does not include loans, conversion, or SWU transactions.

[7] Millions of pounds U_3O_8, equivalent.

[8] US $ per SWU.

[9] Discount from USEC base price on delivery.

[10] Effective 10/1/84.

[11] Calculated using the Nuexco Exchange Value, Conversion Value, and 0.30 percent tails assay. From 10/31/83 through 2/29/84, calculations used the Nuexco SWU Value for DOE origin and FY84 delivery. As of 3/31/84, calculations use the Nuexco SWU Value for DOE origin and FY85 delivery.

[12] US $ per KgU as UF_6, rounded to the nearest $.

[13] Recalculated at 0.30 percent tails assay.

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DECEMBER 1984 NUMBER 196

MONTHLY REPORT

ON THE NUCLEAR FUEL MARKET

NUEXCO

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MONTHLY REPORT ON THE NUCLEAR FUEL MARKET
December 1984 No. 196

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To Our Readers

We are pleased to announce that Mr. **Wayne Fowler,** Senior Vice President in charge of Nuexco's US and Far East brokerage operations, has been named President and Chief Operating Officer effective December 1, 1984. Wayne succeeds George White, Jr., who will move to the position of Senior Consultant-Marketing. The restructuring coincides with Nuexco's planned relocation of our company headquarters to Atlanta, Georgia. The relocation, which will take place during 1985, is one of a series of steps to centralize operations in the Eastern time zone and improve proximity to most of our clients. Since much of the nuclear fuel brokerage business takes place in the Eastern USA and Europe, Nuexco believes that better and more efficient service will be realized by locating in Atlanta. We will continue, however, to maintain an office in Menlo Park to facilitate business with the western states and the Far East. Mr. Fowler, currently located in Nuexco's Northeast Regional Office in Stamford, Connecticut, will relocate to Atlanta in early 1985.

* * *

Nuexco's US offices will be closed for the Christmas holiday on Monday and Tuesday, December 24 and 25, and Monday and Tuesday, December 31 and January 1. Nuexco's European office will be closed December 24 through January 1.

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NATURAL URANIUM AND SECONDARY MARKET CONVERSION

The **Exchange Value** as of November 30, 1984 is **$15.50** per pound U_3O_8, down $0.50 since last month. **Active supply** of natural uranium (U_3O_8 and UF_6) for spot or near-term delivery totals **5,240,000** pounds U_3O_8 or equivalent UF_6, down 21,000 pounds since last month. The corresponding figure for **active demand** is **1,310,000** pounds, up 35,000 pounds. The spot and near-term **supply-demand ratio** fell to **4.0:1.**

The *Current Market Data* section of this Report lists three uranium sales transactions, involving a total of approximately 9,800,000 pounds equivalent U_3O_8. All of those sales involved natural UF_6. Two of the transactions reported this month involved deliveries before 1986, and one met the criteria for inclusion in the current Transaction Value calculation.

The **Transaction Value** as of November 30, 1984 is **$15.90** per pound U_3O_8, down $0.15 since last month. The current Transaction Value includes 11 transactions involving a total of 3.5 million pounds U_3O_8 or equivalent UF_6 and covers a period of 6 months.

The **Loan Use Charge Rate** as of November 30, 1984 is **6 percent** per annum, unchanged since last month in a dormant market.

* * *

The Exchange Value declined to $15.50 largely because of the presence of a major transaction that was concluded at a price well below $16.00. The low activity prevalent for the past several months enhanced the importance of that transaction, since much of the current supply is available at the $16.00 level. In addition, at least two sellers offered significant quantities of material below $15.50, exerting downward pressure on November's Exchange Value.

The general lack of activity this month represents a continuation of the trend exhibited over the past several months in the sale of natural uranium. Sellers have been forced to lower prices substantially to satisfy opportunistic buyers. While the discretionary demand actions by most buyers indicate utilities' lack of interest for immediate forward supply, financial considerations could motivate some sellers to make concessions in order to close deals before January 1. The drop in offering prices that occurred at the end of November failed to draw much new demand into the market. It is still unknown whether buyers will emerge in December unless prices drop still lower.

* * *

The **Conversion Value** is **$0.80** per pound U in UF_6, down $0.20 since last month. The presence of highly discretionary demand precluded the likelihood of purchases at the $1.00 level. Several offers in the $0.80 range combined with counter-bids below that level drove down the Conversion Value. Active supply of secondary market conversion services for delivery within three years amounts to 1.2 million pounds U in UF_6. No active secondary market conversion demand for delivery within three years, and no secondary market conversion transactions, are reported.

ENRICHED URANIUM AND SWUS

The Nuexco **SWU Values** as of November 30, 1984 are:

1. For **DOE origin,** a tails assay of 0.30 weight-percent U_{235}, and certifiable as excess:
   a. For FY85 delivery, $115 per SWU, unchanged;
   b. For FY86 delivery, $15 discount from the USEC base price on delivery, down from $20 last month;
2. For **other** SWUs (includes DOE origin SWUs not certifiable as excess and non-DOE origin SWUs):
   a. For delivery within approximately 15 months, $85 per SWU, down $5;
   b. For delivery in CY86, $95 per SWU, down $3.

Seven secondary market SWU transactions are reported, involving 370,000 SWUs. Active secondary market SWU supply amounts to 475,000 SWUs, while active demand totals 125,000 SWUs.

* * *

The price for DOE origin SWUs certifiable as excess for FY85 appears to be firming, as many November offers were above the $115/SWU level. However, a significant quantity was available for $115/SWU on the last day of the month. Most of the demand for FY85 deliveries has been filled, and few buyers are actively soliciting offers. Many buyers are now focusing on the FY86 market, and with the presence of increasing demand, the discount levels are falling. However, at this early date for FY86 SWUs certifiable as excess, there is wide disparity between the prices sellers are willing to accept and the prices buyers are interested in paying. Consequently, many buyers wanting to purchase FY86 SWUs are waiting in the hopes of getting a better deal. Certifiable FY86 supply is limited, however, because the USEC allowed holders of excess to draw down inventories or reduce by 25 percent previously scheduled AFC deliveries. The buyers of certifiable FY85

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and FY86 SWUs consist mainly of former holders of Requirements-type contracts that signed the USEC for less than 100 percent of their needs.

The market for SWUs of other origin, including DOE SWUs not certifiable as excess and non-DOE SWUs, appears to have little short-term activity in the wake of the USEC signings by many non-US utilities. There is little short-term demand because most such buyers have already purchased and prices are weak. Sellers are trying to generate demand while a few deals in which the certification has been in question wait to be resolved. The majority of buyers interested in other origin SWUs for calendar year 1985 and 1986 comprise two groups:

1. Those that have unfilled requirements and did not sign the USEC, and
2. Those that had signed the USEC and had terminated deliveries in the CY85–86 period prior to December 1983.

Non-DOE SWU suppliers can look to the post-FY86 market for the most activity and interest. All DOE customers that signed the USEC for less than 100 percent of their requirements will be able to fill their remaining requirements from any source, and non-DOE enrichment suppliers will be competing actively for this business. Utilities can expect substantial discounts as more utilities enter the post-FY86 market in the next several months and begin evaluating suppliers' proposals.

Future DOE offers can be expected for this large class of long-term requirements buyers that will emerge soon. Although Cogema and Urenco are price leaders now, DOE's price-cutting strategy and upcoming decision on technology, expected in May 1985, could greatly influence the market for other SWUs after FY86. Many potential buyers will continue to await DOE offers for this portion of demand before selecting a supplier.

DOE: BUSINESS OR GOVERNMENT SERVICE?

In August 1984, testimony was given before the Tri-Committee Advisory Panel on Uranium Enrichment. One of the persons asked to give testimony was Nuexco's CEO, J. Robert Wolcott. A main theme of his testimony was the apparent conflict in objectives arising from whether DOE should be considered a business or a government service. DOE's former assistant secretary for nuclear energy, Shelby Brewer, testifed before the panel, stating DOE's inclination to run as a business. As a result of the testimony, Mr. Wolcott reflected on some of DOE's recent actions as they pertain to its most recent business orientation. Those reflections, following a brief history of the DOE enrichment organization, are summarized below.

Introduction

In the 1960s, the US Government was committed to supporting the nuclear power industry, a commitment which manifested itself in several ways including guaranteed purchases of uranium ore from producers and leasing of fuel to fledgling nuclear utilities. This latter activity required the Government to provide enrichment services to the free world. Presumably, these services were provided because nuclear power was deemed to be a desirable energy source and the Atomic Energy Commission (AEC) was the only entity in the free world capable of providing such a service on a commercial scale. Separative work production was inexpensive and the national interests were well served through the promise of safe, cheap nuclear power and the spreading of fixed enrichment costs over a large international customer base.

In its enrichment enterprise, the AEC was clearly a *service* organization. The early days of private ownership of nuclear fuel saw the same theme carried into the Requirements-type contract where the AEC continued to provide enrichment services as needed on a toll basis (and thus the origination of the term "toll enrichment"). However, in the 1970s several initiatives arose in an effort to provide a more businesslike orientation to AEC's enrichment operations. The goal of these initiatives was ultimately to privatize the supply of enrichment services. Among the shopping list of such initiatives was commercial value pricing, fair value pricing, the Industrial Access Program and the Industrial Participation Program. There were others as well, but the one initiative that has had the most dramatic effect on the nuclear power industry was the introduction of the Long-Term, Fixed Commitment (LTFC) contract. The LTFC contract shifted much of the risk of supply to the customer and thus put the supply of enrichment services on a more "businesslike" basis, notwithstanding the fact that the AEC had a virtual monopoly at the time.

The stage was set for the enrichment enterprise to be turned over to private industry. Coincidentally, in concert with several unrelated events, AEC set the stage for the development of large unanticipated enrichment inventories and the evolution of the secondary market for enrichment services. Later in the decade, the goal of privatization died a quiet death with the failure of Congress to pass the Nuclear Fuel Assurance Act of 1976, and in the

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following year, a new period with renewed emphasis on Government control of the enrichment enterprise would begin.

The passage of the Department of Energy Act and the abolition of the Joint Committee on Atomic Energy had similar effects on their respective branches of Government. Neither the Executive Department nor Congress had single entities whose sole function was to monitor and aid the development of the nuclear industry. Thus enmeshed in the bureaucratic maze, the enrichment enterprise settled into the comfortable position of providing a Government service and moved to perpetuate its existence by pursuing the planning and construction of the centrifuge add-on facility at Portsmouth, Ohio.

The Department of Energy (DOE) relaxed the burden imposed on the nuclear utilities by the LTFC contract with the introduction of the Adjustable, Fixed Commitment (AFC) contract which was in itself a rather burdensome compromise between its two predecessors. One effect of this new contract was to spur secondary market activity and encourage the development of enrichment brokerage operations.

Paralleling this brief history is the development of international enrichment enterprises and the inadvertent buildup of non-DOE separative work unit (SWU) inventories. Inevitably, these non-DOE SWU inventories found their way into the USA via the secondary market encouraged by the astronomical increases in DOE SWU prices during the 1970s and early 1980s. DOE lost billions of dollars to competition in the secondary market, a position which they quickly considered untenable. DOE thus launched a series of moves to combat this unwanted competition culminating in the development of the Utility Services Enrichment Contract (USEC) and its associated conversion terms. Along with the new contract came yet another change in orientation, this time from a service approach to an avowed businesslike approach.

Full Cost Recovery

DOE is required by law to recover full costs "over a reasonable period of time." Using April 1984 data, DOE has argued that a ceiling price of $135 will allow it to recover full costs. DOE uses 10 years as a reasonable period, and over that period, GAO estimates DOE will lose over $3 billion.

DOE estimates that it will sell 192.2 million SWU during the period fiscal year 1985 through fiscal year 1994. Costs during the same 10-year period were forecast at $25,815 million. Dividing projected costs by projected sales, DOE arrived at a *breakeven cost* of $135 per SWU. In other words, if DOE sold all the SWU and spent all the money forecast, they would break even if *all* SWU during the 10-year period were sold at $135 per SWU in FY85 dollars.

However, DOE has also produced a chart which shows projected SWU prices. In this case, the $135 SWU cost, as calculated above, is shown as a *ceiling*, not as projected cost. Prices are forecast to decline to about the $105 to $110 per SWU range by 1994 and declining further from there. At forecast *prices*, the revenue from sales would be about $15 per SWU less projected cost, or ceiling price, for a total loss of almost $3 billion.

In order to reconcile these apparently conflicting data, one need only recognize that DOE adjusts its prices annually on a *rolling* ten-year campaign. Thus, as long as costs per SWU are forecast to decrease in the tenth year, the new breakeven cost will be lower than that calculated the previous year. (Of course, there is some limit below which costs no longer can decline, and at this point the breakeven costs will reach an equilibrium.)

It is this phenomenon that led the GAO to the conclusion that DOE would lose $3 billion over the 10-year period. For example, the April 1984 DOE data projects FY89 sales to be 14.3 million SWU. At a price of $135 per SWU, FY89 revenues would be $1.93 billion. If the next 10-year pricing campaign arrives at a $125 per SWU breakeven cost, the FY89 revenues drop to $1.79 billion in *FY86 dollars*. Translated into FY85 dollars at 7% inflation, the latter projection indicates that DOE will collect $260 million less in FY89 than was necessary to break even at the higher SWU price. This phenomenon would be the same for each of the remaining nine years in the old pricing campaign.

Such a methodology is hardly acceptable to a business concerned with rewarding shareholders for their investment.

DOE Market Forecast

Over the years, DOE's successive market forecasts have proven to be overly optimistic (as have many forecasts). The DOE sales forecast in the April 1984 data estimates sales of a little over 14 million SWU in 1985 and over 23 million in 1994, an increase of 60%. The sales forecast is nearly flat through 1989 on a 14-million-SWU plateau. During 1990 and 1991, it rises to about a 23.5-million-SWU plateau through 1994, a rise of almost 70%.

Nuexco forecasts that free world SWU consumption in 1994 will be 32 million SWU. US consumption will plateau at 12 million about 1988. Assuming that the DOE sales and Nuexco consumption forecasts agree, DOE will

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supply 70% of world consumption in 1994. Even without allowing for any non-US supplied secondary or primary market SWUs used in the USA, DOE production will have to be double the US consumption. DOE must sell more SWU overseas than in the USA to meet their sales forecast. World market share must *increase* despite growing competition.

However, DOE is losing market position in part because of nationalism; the forces of nationalism are permanent, and further erosion is to be expected even if we cannot predict the precise timing.

A business would have to consider the possibility of a market share of only 25% or 50% in excess of US consumption. (A market position that a private US energy exporting company would consider very favorable.)

DOE's April 1984 Pricing Campaign

The table below is derived from DOE's April 1984 pricing campaign by dividing DOE costs by DOE sales.

Fiscal Year	Cost Per SWU	Loss(Gain)/ SWU (@ $135/SWU)	Annual Loss (Gain)	Cumulative Loss
1985	$256.88[1]	$(121.88)	$(1,709,976,000)	$ 1,709,976,000
1986	152.42	(17.42)	(241,615,000)	1,951,591,000
1987	153.76	(18.76)	(254,760,000)	2,206,351,000
1988	173.32	(38.32)	(483,981,000)	2,690,332,000
1989	176.50	(41.50)	(593,450,000)	3,283,782,000
1990	141.95	(6.95)	(131,702,000)	3,415,484,000
1991	115.50	19.50	462,930,000	2,952,554,000
1992	117.78	17.22	413,452,000	2,539,102,000
1993	112.79	22.21	514,161,000	2,024,941,000
1994	104.80	30.20	698,828,000	1,326,113,000
		Less ending inventory		$(1,326,113,000)
		Net		$0

The table above shows that DOE expects to accumulate costs in excess of revenue from sales of approximately $3.5 billion by FY90. Beginning in FY91, costs are less than the SWU price, and the cumulative loss begins to decrease. Since the operation is nonprofit-making, one expects a final cumulative loss to be offset by ending inventory, so this result is not surprising. What is significant, however, is that a positive margin in any year is not experienced until FY91.

A Hypothetical Scenario

Assume for the purpose of this analysis that DOE did several things which are within its power to do. These actions involve making decisions which do not conflict with customer obligations or reliability of supply and are therefore at DOE discretion. The hypothetical, but possible, decisions are as follows:

1. Stop all further investment so that depreciation remains at the current level of $76 million per year.
2. Maintain interest at the same level by deferring investment. Interest would be $553 million per year.
3. Reduce R&D *now* to the level planned for *1991*. That is $20 million per year.
4. Wait for the TVA contract to run out. Use low-cost power sources. Assume the cost of $699 million, as estimated for FY94, is increased 10% to account for diffusion production rather than gas centrifuge, thus making the power bill approximately $770 million per year. Assume all other costs to be the same. The estimated effect (in millions of dollars) of these actions would be as follows:

Power	$770
Operation	399
Depreciation	76
Interest	553
R&D	20
Miscellaneous	-60
Total	$1,758

Providing DOE sold 23.14 million SWU as they forecast, cost for 1994 would be approximately $76 per SWU rather than $105, as they estimate for the course they are presently pursuing.

Furthermore, it is interesting for purposes of sensitivity analysis to compare per unit SWU costs assuming all costs remain constant except sales volume. Assuming two-thirds of the DOE sales volume (or 15.5 million SWU over the 10-year period), the projection would yield:

	Cost Per SWU
Before hypothetical adjustments	$156.45
After hypothetical adjustments	$113.42

The current DOE program would lose $50 per SWU in the event the projected market does not materialize. Under the hypothetical case, the loss would be limited to $37 per SWU. The reason is that high investment and interest charges increase fixed charges. DOE is less capable of adjusting to lower volume. The probability that DOE will realize sales in excess of 23 million SWU per year is very low. The probability of settling for a lower sales volume is very high.

While one cannot draw specific conclusions from the hypothetical case, it is presented as an opinion to stimulate thought. Undoubtedly, DOE's pricing policy will come under increased scrutiny as Congress is asked to comment on incentive pricing and as the date for selection of replacement technology approaches.

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[1] The 1985 Cost per SWU is misleading in that beginning inventory appears to be expenses in that first year. If beginning inventory is subtracted out, the FY85 cost per SWU is $147.40.

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CURRENT MARKET DATA

November 30, 1984	Market Values	Active Supply[1] (thousands)	Active Demand[1] (thousands)
EXCHANGE VALUE	**$15.50**/lb. U_3O_8	5,240	1,310
CONVERSION VALUE	**$0.80**/lb. U in UF_6	1,225	0
SWU VALUES		475	125
DOE origin, certifiable as excess, 0.3 tails assay			
FY85 delivery	**$115**/SWU		
FY86 delivery	**$15** discount/SWU		
Other SWUs (non-DOE or non-certifiable)			
delivery within 15 months	**$85**/SWU		
delivery for calendar year 1986	**$95**/SWU		
LOAN USE CHARGE RATE	**6%**/annum	0	0

	$/lb. U_3O_8	Millions of Pounds	Number of Transactions	Number of Months
TRANSACTION VALUE	**15.90**	3.5	11	6

[1] Supply and demand tables in the *Current Market Data* section of this Report detail the numbers for each category. Quantities of SWUs (Separative Work Units) are not referenced to a particular origin.

DEFINITIONS

1. The **Exchange Value** is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the date indicated.
2. The **Conversion Value** is Nuexco's judgment of the price at which spot and near-term transactions for significant quantities of conversion services could be concluded in the secondary market as of the date indicated.
3. The **SWU Values** represent Nuexco's judgment of the price at which transactions for the sale of significant quantities of SWUs of stated origin for delivery in the specified time period could be concluded as of the date indicated.
4. The **Loan Use Charge Rate** is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the date indicated.
5. The **Transaction Value** is a weighted average price of recent natural uranium sales transactions. The calculation is based on prices paid in:
    a. Transactions closed within the previous three-month period for which delivery is scheduled within one year of the transaction date;
    b. At least ten transactions;
    c. Transactions involving a sum total of at least 2 million pounds U_3O_8 equivalent.

    The sample time is extended as necessary to include these minima. Other currencies are converted to US dollars using conversion rates in effect on or near the transaction date.

DERIVATIONS AND COMMENTS

1. All Market Values are based on:
    a. Data from recently completed transactions.
    b. Data from pending transactions.
    c. Firm bids to buy or borrow, and firm offers to sell or lend.
    d. Prices purchasers or rates borrowers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy or borrow, and prices sellers or rates lenders have expressed a willingness to offer, but for which Nuexco is not aware of firm offers to sell or lend.
2. Prices associated with deliveries under old or renegotiated contracts or other than arm's-length transactions are not considered in the determination of these Market Values.
3. In the determination of the Conversion Value, Nuexco does not consider transportation charges other than those customarily provided by primary suppliers of conversion services.
4. The prices of conversion services or SWUs delivered under long-term contracts with primary suppliers are not considered in the determination of either the Conversion Value or SWU Value.
5. For the DOE SWU Values, Nuexco converts SWU prices at varying tails and product assays to equivalent SWU prices at a tails assay of 0.30 weight-percent U_{235} and a product assay of 3.0 weight-percent U_{235}, assuming feed costs corresponding to the Nuexco Exchange and Conversion Values determined as of the same date.
6. In calculating the Transaction Value, Nuexco does not account for the price of uranium delivered in connection with contracts which call for "market price" mechanisms. This exclusion applies particularly to contracts in which delivery prices are expressed as a function of future Exchange Values or any other indeterminant variable. Also excluded from the calculation are any other transactions in which the delivery price is defined in such a way that it cannot currently be determined.

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CURRENT MARKET DATA

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

	per lb. U_3O_8 in Concentrates			per kg. U in Concentrates		
Country (currency)	**This Month (Nov. 30, 1984)**	**Last Month (Oct. 31, 1984)**	**12 Months Ago (Nov. 30, 1983)**	**This Month (Nov. 30, 1984)**	**Last Month (Oct. 31, 1984)**	**12 Months Ago (Nov. 30, 1983)**
Australia (dollar)	17.99	18.90	24.68	46.77	49.14	64.15
Belgium (comm. franc)	959.16	984.62	1,236	2,494	2,560	3,214
Canada (dollar)	20.49	21.08	27.90	53.27	54.80	72.54
Finland (markka)	99.17	101.59	130.51	257.82	264.10	339.30
France (franc)	145.95	149.39	185.64	379.44	388.39	482.63
FRG (mark)	47.74	48.69	61.06	124.10	126.59	158.74
Italy (lira)	29,451	30,177	36,885	76,566	78,454	95,893
Japan (yen)	3,811	3,927	5,276	9,908	10,210	13,715
Netherlands (guilder)	53.65	54.91	68.41	139.48	142.75	177.85
South Africa (rand)	28.62	30.59	26.41	74.42	79.53	68.56
Spain (peseta)	2,663	2,736	3,507	6,923	7,113	9,117
Sweden (krona)	135.85	139.13	179.57	353.17	361.71	466.84
Switzerland (franc)	39.17	40.06	48.96	101.84	104.15	127.27
UK (pound)	12.88	13.18	15.42	33.50	34.26	40.09
US (dollar)	15.50	16.00	22.50	40.30	41.60	58.50

TRANSACTION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

	per lb. U_3O_8 in Concentrates			per kg. U in Concentrates		
Country (currency)	**This Month (Nov. 30, 1984)**	**Last Month (Oct. 31, 1984)**	**12 Months Ago (Nov. 30, 1983)**	**This Month (Nov. 30, 1984)**	**Last Month (Oct. 31, 1984)**	**12 Months Ago (Nov. 30, 1983)**
Australia (dollar)	18.46	18.96	26.16	47.98	49.29	68.00
Belgium (comm. franc)	983.91	987.69	1,310	2,558	2,568	3,407
Canada (dollar)	21.02	21.14	29.58	54.65	54.97	76.89
Finland (markka)	101.73	101.90	138.34	264.47	264.93	359.66
France (franc)	149.72	149.86	196.78	389.23	389.60	511.59
FRG (mark)	48.97	48.84	64.72	127.31	126.98	168.26
Italy (lira)	30,211	30,272	39,098	78,542	78,699	101,647
Japan (yen)	3,910	3,940	5,592	10,164	10,242	14,538
Netherlands (guilder)	55.04	55.08	72.51	143.08	143.19	188.52
South Africa (rand)	29.36	30.69	27.99	76.34	79.78	72.78
Spain (peseta)	2,731	2,745	3,717	7,101	7,135	9,664
Sweden (krona)	139.35	139.57	190.34	362.28	362.84	494.85
Switzerland (franc)	40.18	40.19	51.89	104.46	104.47	134.91
UK (pound)	13.22	13.22	16.35	34.36	34.37	42.50
US (dollar)	15.90	16.05	23.85	41.34	41.73	62.00

[1] Calculated using currency exchange rates published in the *Wall Street Journal* on November 30, 1984.

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CONVERSION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

	per lb. U as UF_6			per kg. U as UF_6		
Country (currency)	**This Month (Nov. 30, 1984)**	**Last Month (Oct. 31, 1984)**	**12 Months Ago (Nov. 30, 1983)**	**This Month (Nov. 30, 1984)**	**Last Month (Oct. 31, 1984)**	**12 Months Ago (Nov. 30, 1983)**
Australia (dollar)	0.93	1.18	0.66	2.05	2.60	1.45
Belgium (comm. franc)	49.51	61.54	32.97	109.14	135.67	72.68
Canada (dollar)	1.06	1.32	0.74	2.33	2.90	1.64
Finland (markka)	5.12	6.35	3.48	11.28	14.00	7.67
France (franc)	7.53	9.34	4.95	16.61	20.58	10.91
FRG (mark)	2.46	3.04	1.63	5.43	6.71	3.59
Italy (lira)	1,520	1,886	983.61	3,351	4,158	2,168
Japan (yen)	196.71	245.46	140.68	433.66	541.14	310.15
Netherlands (guilder)	2.77	3.43	1.82	6.10	7.57	4.02
South Africa (rand)	1.48	1.91	0.70	3.26	4.22	1.55
Spain (peseta)	137.43	171.00	93.52	302.99	376.99	206.17
Sweden (krona)	7.01	8.70	4.79	15.46	19.17	10.56
Switzerland (franc)	2.02	2.50	1.31	4.46	5.52	2.88
UK (pound)	0.67	0.82	0.41	1.47	1.82	0.91
US (dollar)	0.80	1.00	0.60	1.76	2.20	1.32

SWU VALUES EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	**DOE SWU FY85 (November 30, 1984)**	**Non-DOE SWU delivery within 15 months (November 30, 1984)**	**Non-DOE SWU calendar year 1986 (November 30, 1984)**
Australia (dollar)	133.49	98.67	110.27
Belgium (comm. franc)	7,116	5,260	5,879
Canada (dollar)	152.04	112.37	125.59
Finland (markka)	735.67	543.83	607.81
France (franc)	1,083	800.38	894.54
FRG (mark)	354.17	261.78	292.58
Italy (lira)	218,507	161,505	180,505
Japan (yen)	28,276	20,900	23,359
Netherlands (guilder)	398.06	294.22	328.83
South Africa (rand)	212.37	156.97	175.44
Spain (peseta)	19,756	14,602	16,320
Sweden (krona)	1,008	744.96	832.60
Switzerland (franc)	290.62	214.81	240.08
UK (pound)	95.59	70.66	78.97
US (dollar)	115.00	85.00	95.00

[1] Calculated using currency exchange rates published in the *Wall Street Journal* on November 30, 1984.

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CURRENT MARKET DATA

RECENT TRANSACTIONS[1]

Uranium Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U_3O_8 equivalent)	Approximate Price as Percent of Current E.V.	Seller	Buyer	Remarks
3201	1984	50-100	114	European Entity	European Utility	UF_6. Occurred in mid-1984.
3189	1985	601-1,000	99	Canadian Producer	US Utility	UF_6.
3186	1987–1996	5,001-10,000	see remarks	Canadian Producer	Non-US Utility	UF_6. Price related to market at time of delivery.

[1] Transactions listed are not limited to those in which Nuexco was involved, but also include others of which Nuexco is aware.

Enrichment Services
Secondary Market Sales

Nuexco Transaction Number	Delivery Period[2]	Approximate Quantity[3] (thousands of SWUs)	Approximate Price[4] as Percent of Current SWU Value[5]	Seller Group	Buyer Group	SWU Origin	Remarks
3218	FY85	less than 50	91	US Utility	US Utility	DOE	
3217	FY85	less than 50	97	US Utility	US Utility	DOE	
3209	FY85	50-100	87	European Trader	US Utility	DOE	
3208	FY86	50-100	see remarks	US Utility	US Utility	DOE	Discount was 118% of the current FY86 SWU discount.
3191	FY88	101-300	80	European Entity	European Utility	Eurodif	
3188	FY85	less than 50	R[6]	US Utility	US Utility	DOE	
3187	FY85	50-100	R[6]	US Utility	US Utility	DOE	

[1] Transactions listed are not limited to those in which Nuexco was involved, but also include others of which Nuexco is aware.
[2] Refers to calendar year, not fiscal year.
[3] If tails assay is unknown or unspecified, Nuexco's calculation of SWU quantity assumes 0.30 w/o tails assay.
[4] Price is not normalized to 0.30% tails assay.
[5] Refers to SWU Value that corresponds to SWUs included in transaction. When prices and SWU values are expressed as discounts (e.g., X dollars less than DOE's USEC base price at time of delivery), the percentage refers to the ratio of the *discounts*, not the ratio of the prices.
[6] The notation *R* means that Nuexco either does not know, or that Nuexco has restricted that information to protect client confidentiality.

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URANIUM SUPPLY
(November 30, 1984)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Spot or Near-term[2]	Intermediate or Long-term	Remarks
Available for Sale:			
ACTIVE			
1575	500	500 per year	
1860	400	1,500 per year	
2038	1,000	1,000 per year	UF_6
2288A	40	—	
2288B	295	—	UF_6
2392	35	—	UF_6
2499	15	—	
2516	200	—	
2538*	95	—	
2541*	60	—	
2565*	400	—	
2588*	200	250 per year	1986-90
2648	2,000	—	
2134	—	220 per year	1985-87
2236	—	200 per year	1985-90
2263	—	500 per year	1985-90
2654*	—	1,050	1985-87
TOTAL:	5,240		
INACTIVE			
2191	125	—	UF_6
2275	150	—	
2335	275	—	
2389*	300	—	
2495	130	—	UF_6
2509	1,200	1,600	UF_6
2553	300	—	
2569*	200	—	
2584*	300	—	
0564	—	1,000 per year	1985-90
2271	—	500 per year	1984-88
2297	—	200 per year	1986-89
2326	—	1,000 per year	1989-91
2336	—	250 per year	
2368	—	250 per year	1987-90
2473	—	500 per year	1984-90
2514	—	1,000 per year	
2574*	—	500	UF_6
TOTAL:	2,980		

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*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2193, 2484.

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URANIUM DEMAND
(November 30, 1984)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Spot or Near-term[2]	Intermediate or Long-term	Remarks
Inquiries to Purchase:			
ACTIVE			
2419B*	60	—	UF_6
2533*	300	—	
2539*	125	—	
2548*	300	—	
2568*	50	—	
2590*	475	—	U_3O_8 or UF_6
2217*	—	1,000 per year	1989-95
2442	—	4,000	1986-95
2507	—	600	1987-89
2540*	—	400 per year	1989-94
2555	—	150 per year	1986-91
TOTAL:	1,310		
INACTIVE			
2329	500	—	1985
2576	20	—	UF_6
1999	—	50 per year	1985-90
2244	—	350 per year	1987 on
2414	—	150 per year	1987-91
2457	—	350 per year	1988 on
TOTAL:	520		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2506, 2532, 2563.

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CONVERSION SUPPLY AND DEMAND
(November 30, 1984)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U as UF_6) Within 3 Years	Beyond 3 Years	Remarks
Available for Sale:			
ACTIVE			
2141	1,000	—	
2560	225	—	
TOTAL:	1,225		
INACTIVE			
2051	1,000	—	
2438*	500	250 per year	1985-87
2511	600	700	1986-90
TOTAL:	2,100		

No inquiries to purchase conversion this month.

LOAN SUPPLY AND DEMAND
(November 30, 1984)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Within 1 Year	Beyond 1 Year	Remarks
Available for Loan:			
INACTIVE			
1938	2,000	—	UF_6
2128	700	—	
2139	2,000	—	
2469A	800	—	
2483	550	—	
TOTAL:	6,050		
Inquiries to Borrow:			
ACTIVE			
2453	500	—	
TOTAL:	500		

*New or revised since last month.

[1] Measured from the date of this Report.

No inquiries to borrow this month.

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CURRENT MARKET DATA

SWU SUPPLY
(November 30, 1984)

Nuexco Project Number	Delivery Period[1] (Thousands of SWUs)		Remarks
	Spot or Near-term[2]	Intermediate or Long-term	
Available for Sale:			
ACTIVE			
2100	150	100 per year	
2583*	50	—	
2624*	100	—	
2631*	150	—	
2632*	25	—	
2285	—	300	
2378	—	120	1988
2510	—	50	
2513	—	25	1986
2517	—	150	1986-89
TOTAL:	475		
INACTIVE			
2164*	25	—	
2359	180	—	
2589	50	—	
2531	—	150	1987
2571	—	55	1987
TOTAL:	255		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes SWUs deliverable within one year under other than spot or near-term contracts.
Projects removed since last month: 2408, 2580, 2628.

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SWU DEMAND
(November 30, 1984)

Nuexco Project Number	Delivery Period[1] (Thousands of SWUs): Spot or Near-term[2]	Delivery Period[1] (Thousands of SWUs): Intermediate or Long-term	Remarks
Inquiries to Purchase:			
ACTIVE			
2443*	45	—	
2480*	70	—	
2655*	10	—	
2519	—	30 per year	1987 on
2550*	—	45	1986
2578	—	150	1986
2653*	—	100	1986-90
TOTAL:	125		
INACTIVE			
2543*	25	25	1986
2500*	—	500	1987-90
2512	—	15 per year	1987 on
2585*	—	100	1986
TOTAL:	25		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes SWUs deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2459, 2550, 2604, 2688.

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ANALYSIS & COMMENTARY

OPTIMUM TAILS ASSAY—Part 2

Introduction

This is the second in a series of articles on the enrichment tails assay. Part I (Report 195) covered the theory and economics of the enrichment process, including the method for determining the enrichment tails assay that yields the minimum product cost. This article will show how the tails assay for minimum product cost changes when the unit price of enrichment services depends on the tails assay. The final installment will discuss the dependence of the unit cost of feed material on the tails assay and the true optimum tails assay.

Primary Market SWU Cost Dependence on Tails Assay

The concept of the separative work unit (SWU) was originally devised to provide a standard unit of work that was independent of enrichment and tails assay. In the past, most enrichment services were obtained from primary suppliers that priced their services on this theoretical basis; i.e., so many dollars per SWU.

In the last few years, projections of required enrichment services have been reduced to the point where both the USDOE and Eurodif have excess enrichment capacity. In this period of shrinking load projection, the DOE has become concerned about its fixed production costs. When excess capacity exists, the fixed costs per SWU (for items such as depreciation and development) will be increased whenever the quantity of SWUs delivered are reduced. SWU sales can be reduced by contract cancellations, reductions of requirements, or through the mechanism of the variable tails assay option (VTAO). By increasing their transaction tails assays, customers can fulfill their requirements with fewer SWUs, thus increasing the fixed cost for every SWU produced by DOE.

DOE's VTAO Surcharge

To counteract the loss of SWU sales due to their customers' exercise of the VTAO, DOE instituted a new pricing policy in converting its customers to the new Utility Services enrichment contract (USEC); the Variable Tails Assay Option (VTAO) Surcharge. The VTAO is offered for all deliveries under the USEC contract beginning in 1987. The VTAO surcharge, which increases the unit price for SWU at tails assays above 0.20 weight-percent U_{235} (w/o), is a maximum of 0.7 percent of the base contract price for every 0.01 w/o by which the tails assay exceeds 0.20 w/o.* The resulting SWU cost for USEC deliveries is determined as follows:

SWU Cost = Base Contract Price[0.86 + (0.7 × Tails Assay)]

[Note: In this equation, tails assay must be expressed in w/o, and is subject to a minimum of 0.20.]

The current Base Contract Price is $135 per SWU, so the total SWU cost ranges from $135 at tails assays of 0.20 w/o (or less), to $144.45 at a tails assay of 0.3 w/o. The effect of the maximum VTAO charge on the cost of enriched product is shown in Figure 1, which shows the cost of a kilogram of 3.50 w/o enriched product for a base SWU price of $135 and feed costs of $50/KgU, with and without the VTAO surcharge. The VTAO reduces the variation of product cost with tails assay, so that the DOE effectively shares any savings for higher tails assays.

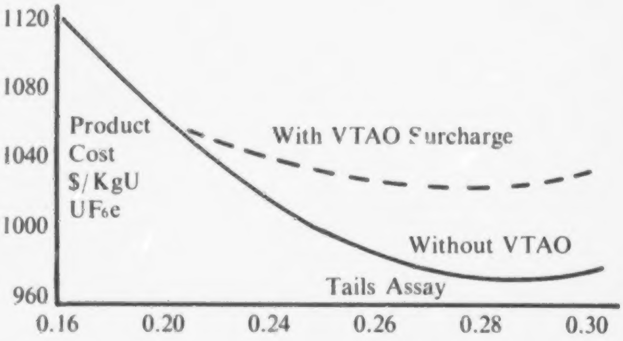

Figure 1. Cost of 3.50 w/o Product as a Function of Tails Assay for Feed at $50/KgU and Enrichment at $135/SWU.

As the VTAO surcharge increases the cost of SWU at higher tails assays, it will reduce the tails assay for minimum product cost. If the maximum surcharge is applied, the optimum tails assay can be found from the equations in the Appendix to this article. The tails assay for minimum product cost with the VTAO surcharge is compared to the tails assay for minimum product cost *without* the surcharge in Figure 2.

The VTAO surcharge makes the tails assay for minimum product cost about 0.03 w/o less than the tails assay

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*A significant portion of the DOE's "fixed" cost is the demand charge it pays to its electrical suppliers. As it has been unable to eliminate the demand charge for SWUs (electric power) not taken under higher tails assays, the DOE is passing this cost on to its customers in the VTAO surcharge.

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for minimum cost without the surcharge. As a result, the VTAO surcharge will induce the DOE customers to use more SWU and less feed. The tails assay for minimum product cost with VTAO is also a weak function of the product enrichment, being slightly higher at lower enrichments.

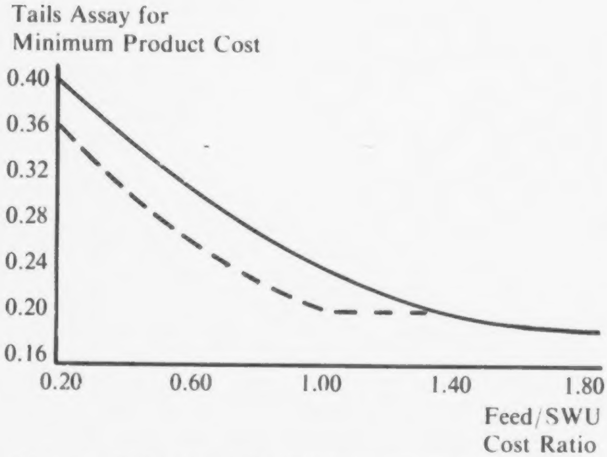

Figure 2. Tails Assay for Minimum Product Cost as a Function of the Feed/SWU Cost Ratio for Natural Uranium Feed at an Enrichment Level of 3.50 w/o.

Secondary Market SWU Cost Dependence on Tails Assay

While most primary enrichment suppliers do not impose a surcharge for SWUs at higher tails assays, the price of enrichment services on the secondary market is often a function of the tails assay. Most secondary market transactions are de-enrichment swaps, wherein a seller holding excess enriched uranium or an unneeded delivery contract swaps enriched product to a buyer in return for cash plus the natural uranium feed theoretically necessary to produce the enriched product. The amount of cash is determined by the number of SWUs theoretically necessary to produce the enriched product, times some established price per SWU. Although the tails assay is technically immaterial in such transactions, its use as the device for computing cash, feed and SWU quantities makes it important.

The material and cash flows in a de-enrichment swap are illustrated in Figure 3. (Report 189, pages 25-27, describes in more detail the mechanics of the de-enrichment swap.) In this example, a one-kilogram quantity of enriched product at 3.50 w/o is de-enriched at 0.3 w/o tails assay. The quantity of feed returned and the number of SWUs purchased from the seller are the Feed Factor and SWU Factor for the given product enrichment and tails assay.

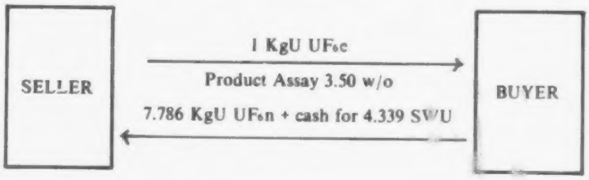

Figure 3. Hypothetical De-enrichment Swap (Using Tails Assay of 0.3 w/o).

The tails assay assumed for the transaction is a variable which should be established by the economic parameters of the parties to the transaction. To establish the appropriate tails assay, we will first look at the economics of the SWU seller.

Secondary Market SWU Prices and Transaction Tails Assay from the Seller's Viewpoint

From an economic viewpoint, the seller is giving up the value contained in his enriched product in exchange for cash plus the value of the returned feed. In the example illustrated in Figure 3, assume that the seller values 3.5 w/o enriched product at $900/KgU, and puts a value of $50/KgU on returned feed material. At what price should he sell the contained SWUs?

The *breakeven SWU price* is defined as that which would produce the same overall cost of product as if the sale had not been made. Transforming the equation for cost of enriched product, the breakeven SWU price is derived as:

$$\text{Breakeven SWU Price} = \frac{\text{Product \$/KgU} - \text{Feed \$/KgU} \times \text{Feed Factor}}{\text{SWU Factor}}$$

At a tails assay of 0.30 w/o, the resulting equation becomes:

$$\text{Breakeven SWU Price} = \frac{\$900 - \$50 \times 7.786}{4.339} = \$117.70$$

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Thus, at a tails assay of 0.30 w/o, the seller needs to obtain a price *greater than* $117.70 to have any incentive to make the deal.

Similarly, if the seller chose a tails assay of 0.20 w/o, the SWU price needed to break even would be $106.60. If the SWU price were established so that the seller received the same total value for his enriched product, he should be indifferent to the transaction tails assay of the de-enrichment swap. Such an indifference curve of SWU price versus tails assay, which can also be labeled the "Seller's Constant Product Value Curve," is shown in Figure 4.

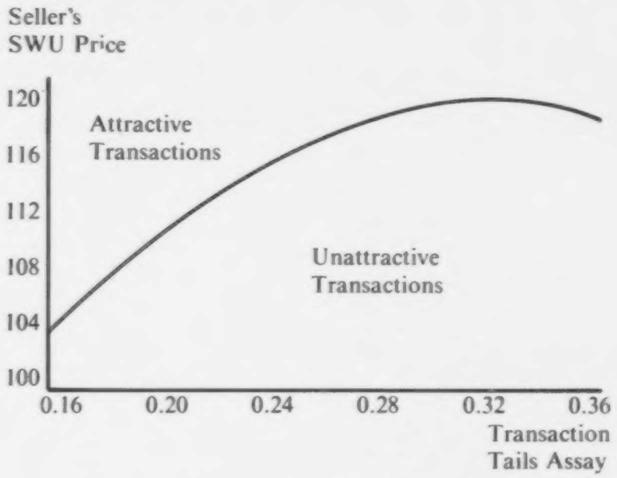

Figure 4. Seller's Constant Product Value Curve.

Any transaction having a SWU price above the Constant Product Value Curve will be attractive to the seller, as he will receive more than his established value of $900/KgU for his enriched product.

Secondary Market SWU Prices and Transaction Tails Assay from the Buyer's Viewpoint

Buyers in the secondary SWU market are likely to be utilities that do not have firm commitments to purchase enrichment services from a primary SWU supplier, and wish to take advantage of the lower prices offered on the secondary market. Assuming that the buyer holds natural uranium, the de-enrichment swap allows the buyer to purchase the required enrichment product in a manner similar to the primary enrichment services contract; exchanging cash and feed material for the enriched product.

Continuing the example started above, assume for the moment that a buyer needs 3.50 w/o enriched product, and has a marginal feed value of $100/KgU. His feed value is higher than the current market, but may be based on the historical cost of inventory material or on future deliveries contracted for at a time when prices were higher.

The buyer receives an offer from the seller for a de-enrichment swap for $117.70 per SWU at 0.30 w/o tails. The buyer's product cost under this offer would be:

$$\begin{aligned}\text{Product Cost} &= \text{Feed Value} \times \text{Feed Factor} \\ &\quad + \text{SWU Cost} \times \text{SWU Factor} \\ &= \$100 \times 7.786 + \$117.70 \times 4.339 = \$1289/\text{KgU}.\end{aligned}$$

To compare this enrichment offer to others made at different tails assays, a Curve of Constant Product Cost for the buyer can be constructed in a manner similar to the seller's Constant Product Value Curve, using $1289/KgU for the product cost and $100/KgU for the feed. This Constant Product Cost Curve is shown in Figure 5. If the buyer can buy SWU at prices below this constant cost, or buyer's indifference curve, he will have reduced his fuel costs.

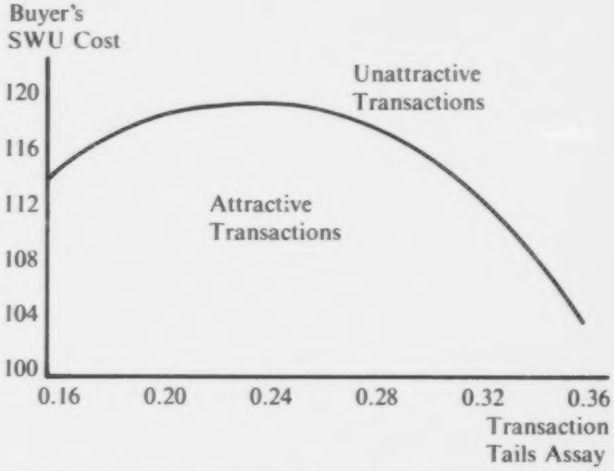

Figure 5. Buyer's Constant Product Cost Curve.

A Successful Secondary SWU Transaction

If the buyer receives no other offers with SWU prices below the constant cost curve in Figure 5, the seller has made the most attractive offer in this hypothetical example. However, even this offer may be improved by the selection of an appropriate transaction tails assay.

Superimposing the buyer's and seller's indifference curves in Figure 6, a common area appears where the participants may derive further benefits from the transaction.

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This is the area which is above the seller's Constant Product Value Curve, and below the buyer's Constant Product Price Curve.

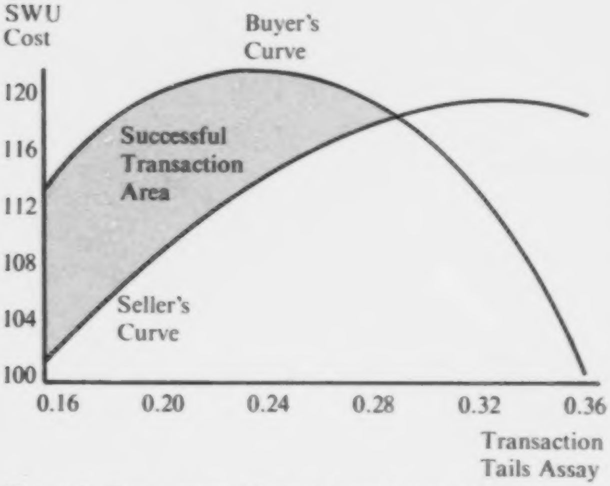

Figure 6. Comparison of Buyer's and Seller's Indifference Curves.

In this example, the largest positive difference between the two curves occurs at low tails assays. If the transaction took place at 0.16 w/o tails, rather than the 0.3 w/o tails offered by the seller, the value added by the tails assay change would be about 13% of the cost of the SWUs.

The Role of the Intermediary

In many cases, the buyer and/or seller have institutional constraints that prevent them from changing the tails assay, and so an intermediary, or market maker, is used to facilitate the transfer. The intermediary can buy the SWU from the seller at his offered tails assay and sell the equivalent SWU to the buyer. The current secondary SWU market is a buyer's market, so the seller usually makes a firm offer, which is then optimized by the intermediary and offered to the buyer as a better value than the unaltered transaction. Assuming that the intermediary (who will receive a commission from the SWU seller) passes on all of the benefits of the tails assay change to the buyer, this transaction is illustrated in Figure 7.

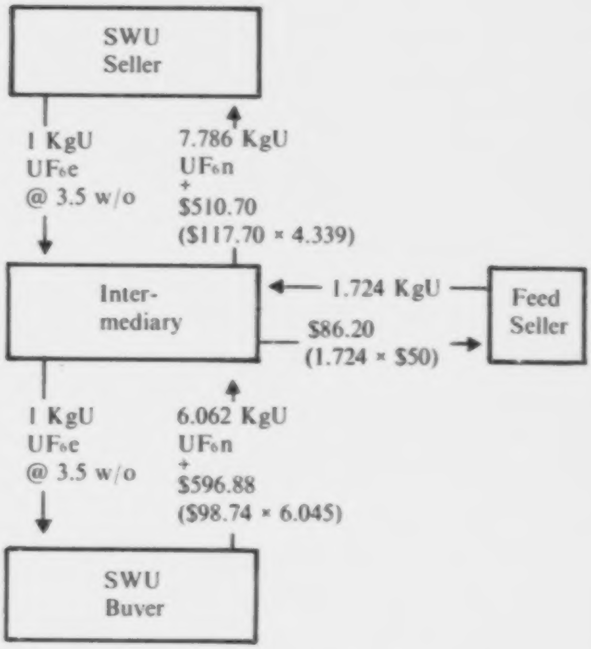

Figure 7. De-enrichment Swap with Intermediary (Change from 0.3 w/o to 0.16 w/o tails).

The intermediary receives more cash from the buyer than he pays to the seller, but the feed quantity to be returned to the seller is greater than that provided by the buyer. The intermediary uses the extra cash to purchase the additional feed required from a fourth party or supplies it from his inventory. The intermediary is the party that is changing the tails assay, and his marginal feed value (usually near the spot market price) determines the Constant Product Value Curve. With an intermediary who passes on all of the benefits of the tails assay change, the buyer's net product cost is shown as a function of tails assay in Figure 8.

The buyer's tails assay for minimum product cost is less than 0.16 w/o. At 0.16 w/o tails the buyer's product cost is \$1203/KgU as enriched UF_6, compared to \$1289 for the seller's offer at 0.30 w/o tails. While the cost continues to decrease at lower tails assays, this is beyond the range where past transactions have taken place, and some accounting questions may need to be addressed.

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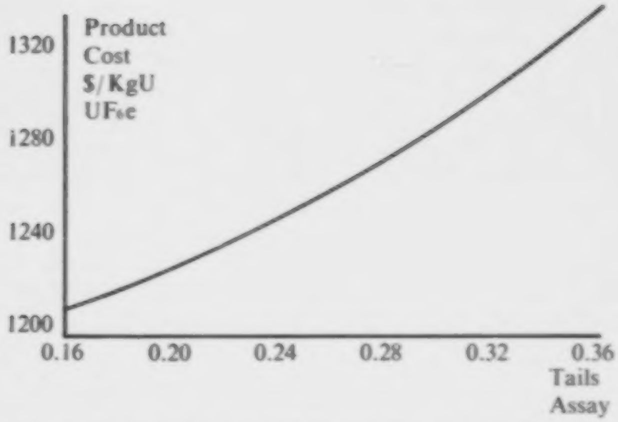

Figure 8. Buyer's Cost of 3.50 w/o Product on the Secondary SWU Market.

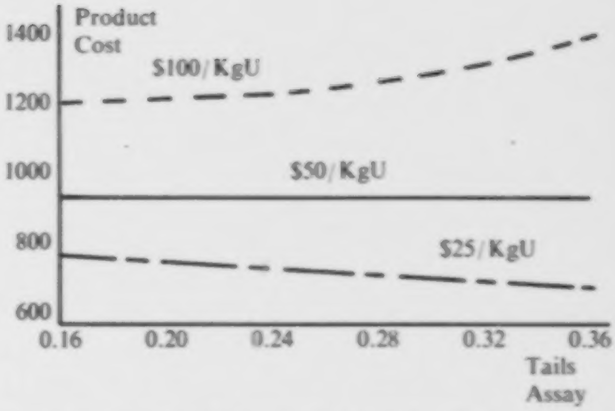

Figure 9. Cost of 3.50 w/o Product for Various Feed Costs (Seller's SWU Price Based on $50 Feed).

If the buyer had used the classic concept of the optimum tails assay (the tails assay for minimum product cost at a *constant* SWU price), with $117 per SWU and $100/KgU feed, he would have concluded the optimum tails was 0.24 w/o, with a corresponding product cost of $1271/KgU.

Analysis

While the above example shows that the transaction tails assay can have a considerable effect on secondary market SWU purchases, the reader has probably observed that the driving force behind the cost improvement was the relatively high value assigned to feed material by the SWU buyer. The final essay in this series will show that the proper feed value to use in tails assay optimization is the expected market value for *replacement* feed, discounted from the time of replacement. As more participants in the market begin to recognize this fact, they will begin to use nearly the same indifference curves, and the *real* value of secondary market SWU will become almost independent of tails assay. This point is illustrated by Figure 9, where the net product cost to the buyer shown in Figure 8 is repeated for other marginal feed values.

Note that when the buyer and seller use the same feed value, the enriched product cost is not a function of tails assay at all. In a rational market, there will be differences in marginal feed value due to varying perceptions of future uranium costs, but they should not be of the magnitude used in Figure 9. If the sellers or buyers deviate from the Constant Product Value Curve based on the spot market value of feed material, an intermediary should be able to adjust the tails assays with feed sold from or to the spot market to give them the benefits of that difference.

Summary

Part 2 of the tails assay article has focused on some of the market conditions that make the cost of SWU depend on the enrichment tails assay, and developed the cost of enriched product as a function of tails assay under these conditions. The results of these analyses show that the tails assay for minimum product cost is a complex function of the economic parameters for both the SWU buyer and the SWU seller. General rules developed for past primary market transactions simply *do not apply* to the secondary SWU market.

Because of the complexity of these functions and a variety of contractual and institutional constraints on the buyers and sellers, there may be an increasing role for intermediaries who are familiar with these relationships and can use arbitrage techniques to resolve the conflicts between the economic parameters of the primary parties.

One of the primary conclusions from Part 2 is that the variation of enriched product cost with tails assay is most sensitive to the cost of feed material used in the evaluation. The final essay will address this issue by focusing on the fuel cycle economics of utilities as SWU buyers and secondary market sellers.

Appendix

Tails Assay for Minimum Product Cost with Maximum DOE VTAO Surcharge

The following series of implicit equations can be solved by iteration on a computer or programmable calculator. In this series of equations, the feed is assumed to be 0.711

w/o, and the assays are in units of weight percent, in contrast to the other equations in this article which use assay as weight fractions (weight percent = weight fraction × 100).

$$A = (\text{Tails w/o} / 50 - 1) \times (0.711 - \text{Tails w/o})$$

$$\begin{aligned} B' = {} & 4.868883 - (\text{Cost Ratio}) \\ & + 0.985780 \times \text{Ln}\,[\text{Tails w/o} / (100 - \text{Tails w/o})] \end{aligned}$$

$$\begin{aligned} S = {} & 0.7 \times \text{SWU Factor} \times (0.711 - \text{Tails w/o})^2 \\ & /[(\text{Enrichment w/o} - 0.711) \times (0.86 - 0.7 \times \text{Tails w/o})] \end{aligned}$$

$$\text{Tails w/o} = A \times 100 /[(100 - \text{Tails w/o}) \times (B' - S)]$$

The above relationships assume a VTAO credit for tails assays less than 0.2 w/o. As a result, they are incorrect for tails less than 0.2 w/o, and must be adjusted to the lesser of 0.2 w/o or the tails assay for minimum product cost without the credit (Report 195).

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FOCUS

SWEDEN

Introduction

Sweden has emerged as a world leader in the use of nuclear energy and the development of nuclear technologies. Ten reactor units now generate electricity for commercial sale, and two 1050-MWe BWRs are scheduled to begin commercial operations by mid-1985. Thus, while Sweden's population is only 8.3 million, its operational nuclear generating capacity is surpassed by that of only six other nations.[1]

Like many industrialized nations, Sweden's principal motivation for developing nuclear energy has been to reduce the percentage of energy requirements supplied by imported oil. Nuclear power and hydroelectric power now generate more than 95 percent of the country's electricity (Table 1), and electricity use has been growing steadily in recent years. Sweden possesses substantial low-grade uranium reserves that could be exploited in the event of a foreign uranium supply cutoff. The three principal nuclear power utilities currently import uranium from a range of sources, and have participated actively in international markets in order to minimize fuel costs.

Table 1

1983 ELECTRICITY CONSUMPTION BY SOURCE IN SWEDEN

Source	Generation (TWh)	Percent of Total
Hydroelectric	62.3	59
Nuclear	39.2	37
Coal and other	4.0	4

Source: *Swedish Nuclear News,* March 1984.

Nuclear Power Utilities

Because it lacks significant known resources of oil, coal or natural gas, Sweden depended on oil imports for over 80 percent of energy requirements in the early 1970s. The desire to reduce its energy trade deficit and diversify the nation's energy base was the principal motive for developing nuclear power. Thus far, nuclear power has replaced more than 10 percent of total energy consumption. In addition, since the early 1970s, new hydroelectric installations, imports of hard coal, and the use of forest products for heating have supplanted a further 15 percent of energy needs; oil imports now supply only 55 percent of Sweden's total energy. A government bill passed in 1981 and recently reaffirmed by the Swedish parliament (Riksdag) calls for the continued reduction of oil use to 40 percent of total energy consumption.

The four commercial nuclear power installations in Sweden have a total of 12 reactors (Table 2). The Oskarshamn plant (Figure 10), the site of the first commercial unit built in the country, is owned and operated by OKG, a consortium of private companies led by Sydkraft (38 percent). All three of the Oskarshamn units are Asea Atom BWRs with turbine generators built by Stal Laval. (The industrial conglomerate Asea and the Swedish government share ownership of Asea Atom; Stal Laval is a subsidiary of Asea.) Oskarshamn Units 1 and 2 achieved average capacity factors of 81.7 and 80.2 in 1983, and Unit 1 was the best performing reactor in Europe in the first half of 1984, achieving a capacity factor of 93.6. OKG anticipates fuel loading at Unit 3 in December 1984, with commercial operation in mid-1985. Oskarshamn Unit 3 and Forsmark Unit 3 are the largest BWRs Asea Atom has sold to date.

Sydkraft is the second largest electric utility in Sweden after the State Power Board (SSPB). The Barseback plant near Malmo (Figure 11) is operated by the Sydkraft subsidiary Sydsvenska Varmekraft AB. Both 570-MWe Barseback units achieved high availability and capacity factors in 1983; Unit 2 had a capacity factor of 89.4 in the first half of 1984.

SSPB's four-unit Ringhals plant, located just south of Goteborg on the west coast, is the largest nuclear power facility in Sweden. Ringhals Units 2, 3 and 4 are Westinghouse PWRs, the only commercial reactors in the country not supplied by Asea Atom. Ringhals Unit 4 began commercial production in November 1983; on January 23, 1984, all four Ringhals units operated at 100-percent power for the first time (3,350 MWe net). SSPB also is the majority owner (74.5 percent) and operator of the Forsmark plant north of Stockholm. The utility received a fuel loading license for Forsmark Unit 3 in October, and expects to begin full power generation in mid-1985.

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[1] The six nations having greater operational capacity are the USA, France, the USSR, Japan, the Federal Republic of Germany, and the United Kingdom. Canada currently has a larger installed capacity, but its Pickering Units 1 and 2 are not in service.

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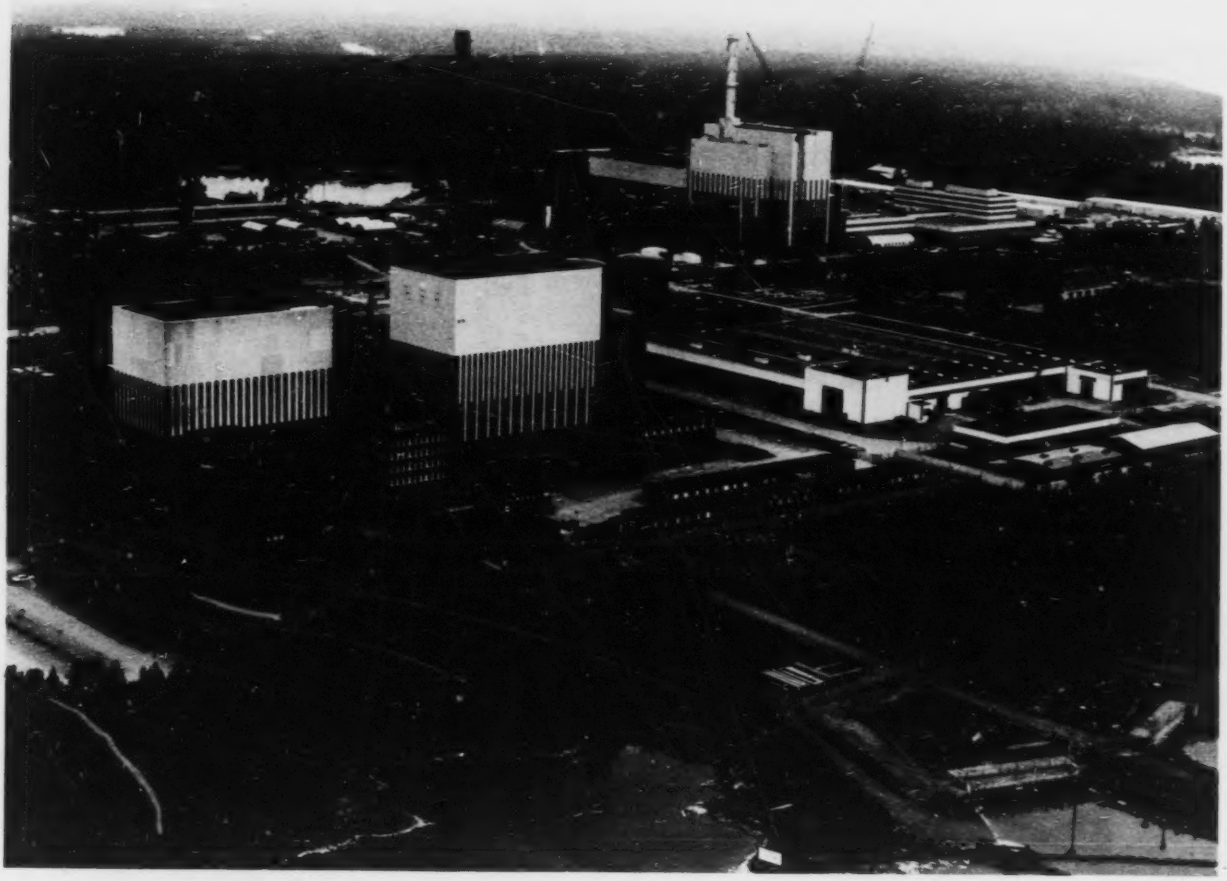
Nuclear Power Politics

In March 1980, shortly after the Three Mile Island incident in the USA and amid widespread anti-nuclear sentiment throughout the Western world, Swedish voters accepted a popular initiative calling for the eventual phasing out of commercial nuclear power in their nation. A year after the passage of the referendum, the Riksdag established 2010 as the year in which the goal would be achieved. The precise schedule for the phase-out has not yet been determined, nor have specific plans been formulated for the construction of replacement power facilities. A Riksdag committee concluded earlier this year that implementation of the decision is feasible, particularly if the nation achieves a reduction in total energy consumption over the next several decades, although not without considerable costs. The committee estimated that if all 12 units are still functioning well by the turn of the century and the ban is implemented, taxpayers could end up paying up to $1 billion for each year the units would have remained in operation.

At this time it is difficult to predict whether the nuclear power phase-out actually will transpire. In recent years, the strength of Sweden's conservative political party, the Moderates, has grown to 28 percent, while that of the anti-nuclear green party, the Centre, has declined to approximately 12 percent. The Centre Party led a coalition government in the late 1970s and unsuccessfully attempted

Figure 10

OSKARSHAMN NUCLEAR POWER PLANT



to terminate the utilities' nuclear power projects. It appears at the present time that Sweden may be moving in the political direction of other Western nations that have encouraged the growth of nuclear power through new economic policies.

The majority Social Democratic Party, led by Prime Minister Olof Palme, historically has taken a somewhat ambivalent position toward nuclear energy. The government taxes oil, coal and nuclear-generated electricity to subsidize soft energy sources. However, it is unlikely such sources will ever supplant a substantial percentage of growing energy needs. Ultimately, environmentally-conscious Swedes may decide it is not in their best interest to replace nuclear power with more hydroelectric dams, or with fossil fuel plants that require vast imports of coal or oil, and which have substantially more adverse environmental impacts.

Waste and Safety Issues

Two existing laws governing nuclear energy place heavy emphasis on the assurance of safe and effective means to close the fuel cycle. The Nuclear Stipulation Law, which came into effect in May 1977, stipulated that fuel may not be loaded in a reactor until the reactor operator has shown the government authority that high-level waste will be handled and disposed of safely. It also required utilities to obtain reprocessing contracts before nuclear units could be licensed. The 1984 Act on Nuclear Technical Activities, which in February of this year replaced several laws including the 1956 Atomic Energy Act, removes the requirement to have reprocessing contracts in place (there is still a requirement to show the capability for eventual reprocessing) and dictates that each reactor owner must carry out a comprehensive research and development program at least six years long to ensure safe disposal of wastes and safe plant decommissioning. Approximately one-third of the utilities' accountable fuel costs finance future expenses related to the back end of the fuel cycle.

In their efforts to resolve waste management issues, the

Table 2

COMMERCIAL NUCLEAR POWER PLANTS IN SWEDEN

Unit	Utility	MWe (net)	Type	Commercial Operation Date	1983 Capacity Factor
Oskarshamn 1	OKG[1]	440	BWR	Feb 1972	81.7
Oskarshamn 2	OKG	595	BWR	Dec 1974	80.2
Oskarshamn 3*	OKG	1050	BWR	Nov 1985	—
Barseback 1	Sydkraft[2]	570	BWR	Jul 1975	80.2
Barseback 2	Sydkraft	570	BWR	Jul 1977	75.2
Ringhals 1	SSPB[3]	750	BWR	Feb 1976	49.7
Ringhals 2	SSPB	800	PWR	May 1975	56.2
Ringhals 3	SSPB	915	PWR	Apr 1981	36.3
Ringhals 4	SSPB	915	PWR	Nov 1983	61.4[4]
Forsmark 1	FKA[5]	900	BWR	Dec 1980	75.2
Forsmark 2	FKA	900	BWR	Jul 1981	69.5
Forsmark 3*	FKA	1060	BWR	May 1985	—
Total MWe Capacity		9,465			

*Presently under construction. Forsmark 3 has received a fuel loading license.

[1] Sydkraft AB owns 38 percent of OKG.

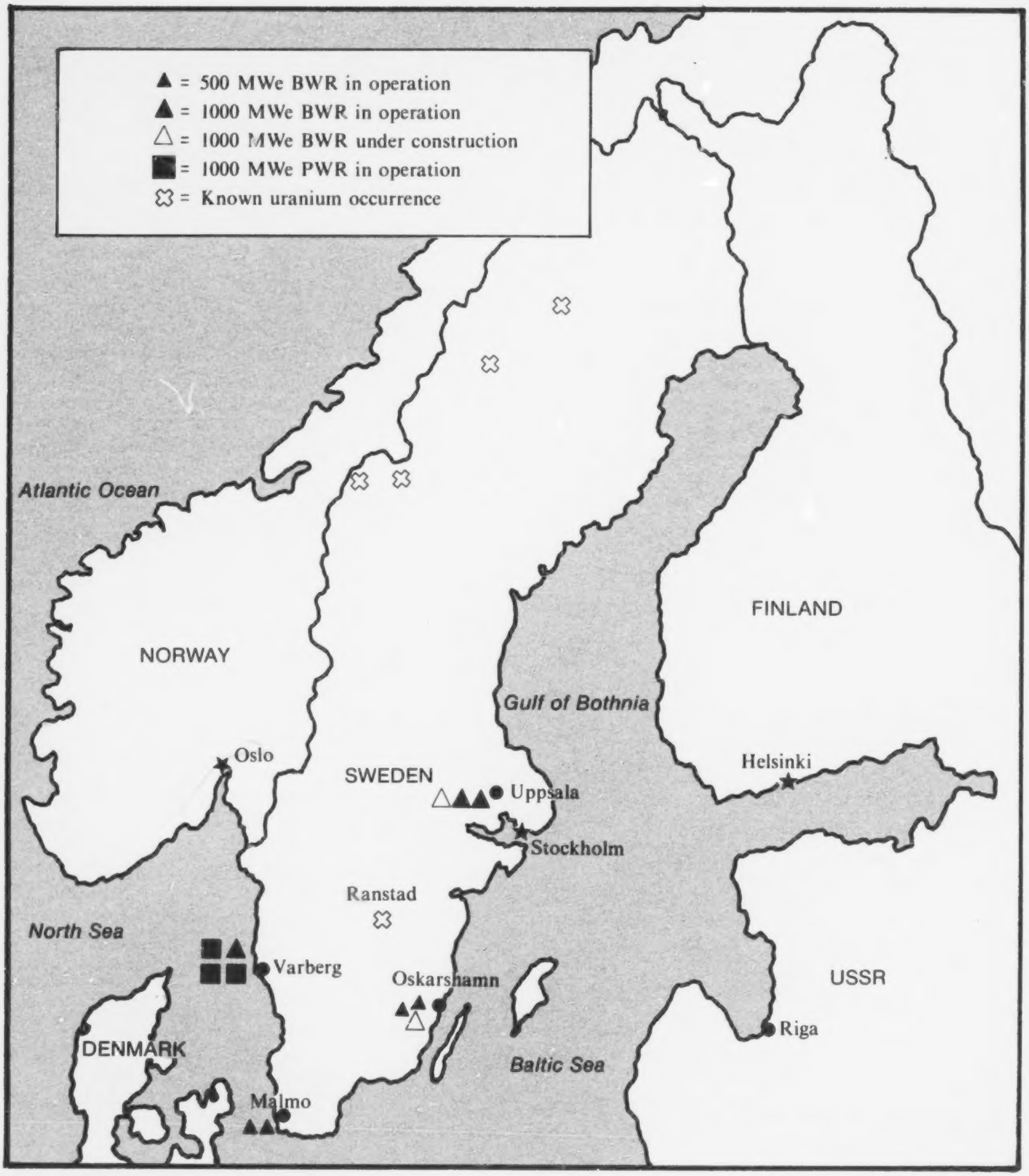
[2] Sydvenska Varmekraft AB, a subsidiary of Sydkraft AB, is the owner and operator of the Barseback plant.

[3] SSPB = Swedish State Power Board (Vattenfall).

[4] Capacity factor for between November 11, 1983, and December 31, 1983.

[5] FKA = Forsmarks Kraftgrupp AB. SSPB owns 74.5 percent of FKA and is the operator and fuel purchaser for the plant.

Figure 11
SWEDEN AND NEIGHBORING COUNTRIES


▲ = 500 MWe BWR in operation
▲ = 1000 MWe BWR in operation
△ = 1000 MWe BWR under construction
■ = 1000 MWe PWR in operation
✣ = Known uranium occurrence
Atlantic Ocean
NORWAY
Oslo
SWEDEN
Uppsala
Stockholm
Gulf of Bothnia
FINLAND
Helsinki
Ranstad
North Sea
Varberg
Oskarshamn
DENMARK
Malmo
Baltic Sea
USSR
Riga

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four nuclear power utilities have pooled resources to form the Swedish Nuclear Fuel and Waste Management Company, SKB (Svensk Karnbranslehantering AB) (Table 3). SKB has organized Sweden's four principal waste management projects:

1. **SFR:** A facility for the permanent storage of all low and medium-level wastes, to be located under the seabed near the Forsmark plant. Sitework began early in 1984.
2. **CLAB** (Central Temporary Storage Facility for Spent Fuel): A facility for the intermediate storage of spent fuel, located in a rock cavern at Simpevark, near the Oskarshamn plant. SKB commissioned OKG for both construction and operation of CLAB. The facility is now virtually complete; shipments will begin arriving early in 1985.
3. **M/S Sigyn:** A special ship designed for the transport of spent nuclear fuel. It began operating in 1982, taking shipments for reprocessing to Cogema and BNFL, and will begin shipments to CLAB in the coming months.
4. **SFL:** A repository for the final storage of high-level and long-lived radioactive wastes. The Nuclear Power Inspectorate and the National Institute of Radiation protection have approved a proposal for SFL that followed years of research and development. Wastes will be stored in special copper cannisters within a geologic repository 500 meters underground, to be backfilled with bentonite.

Table 3

OWNERSHIP OF SKB[1]

Utility/Company	Percent Share
OKG	22
Sydkraft[2]	12
Swedish State Power Board	36
Forsmarks Kraftgrupp AB (FKA)	30

[1] SKB = Svensk Karnbranslehantering, the Swedish Nuclear Fuel Supply Company. SKB owns most of the facilities in Sweden having to do with the back end of the fuel cycle. It also controls an enriched uranium stockpile equivalent to approximately one year forward consumption for the operating nuclear units, and conducts exploration for domestic uranium.

[2] Sydkraft AB owns 12 percent through its subsidiary Sydsvenska Varmekraft AB.

Fuel Supply

Sweden possesses the largest known uranium resources in Western Europe. The most well-known deposit is found at Ranstad in the south central part of the country. It is a large, low-grade (0.03 percent), homogeneous orebody located in alum shale, having a recoverable potential of some 300,000 metric tons U_3O_8. No commercial quantities of uranium have been mined from Ranstad since 1975, although a company formed to exploit the deposit had been evaluating it for several years. The principal obstacles to commercial development are local opposition and low ore grade; in the event of a foreign uranium supply cutoff, both obstacles could be overcome. SKB and the Swedish government have prospected for uranium throughout the country, and a group of low-grade deposits has been identified near the Arctic Circle. SKB completed a long evaluation project at Pleutajokk in September 1981. During 1983, test drilling at Lilljuthatten in the municipality of Krokom indicated a U_3O_8 reserve of at least 2,000 tonnes, with average ore grade exceeding 0.1 percent. (Swedish uranium occurrences are reviewed in Report 169, September 1982.)

Since 1981, OKG has owned 1 percent of ERA (Energy Resources of Australia), and the utility took delivery of over 800,000 pounds U_3O_8 from the Ranger mine in 1983. Enrichment services for Oskarshamn Units 1 and 2 are covered by 3.5-year Requirements contracts with DOE; a contract between SKB and Techsnabexport provides enrichment for Unit 3. OKG chose not to convert to DOE's Utility Services enrichment contract (USEC), and has purchased some SWUs from secondary market sources. One large secondary market transaction in late 1983 involved a sale of some 1.3 million SWUs, for delivery between 1986 and 1990, from ENEL (Ente Nazionale per L'Energia Elettrica) to the Swedish utilities. OKG will receive approximately one-third of the ENEL SWUs.

Both Sydkraft and SSPB purchase most of their natural uranium from Canadian sources, and principally from SMDC (Saskatchewan Mining Development Corporation). SSPB buys fuel for the three Forsmark units as well as the Ringhals plant. Both Sydkraft and SSPB have contracts with DOE for enrichment services, while Sydkraft converted its Requirements contracts and five AFCs (Adjustable Fixed-commitment contracts) to the USEC. A government bill passed in June 1982 called for the stockpiling in Sweden of enriched uranium equivalent to 35 TWh of nuclear-generated electricity. At the present time, SKB manages the stockpile.

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RECENT DEVELOPMENTS

AUSTRALIA

The Chairman of Western Mining Corporation (WMC) announced that full production of the Olympic Dam project (Roxby Downs) will be achieved in stages because of limited uranium market opportunities before 1990. Detailed development plans for the project will be available only after the completion of the feasibility study sometime next year. WMC and BP Australia are funding the A$150 million study.

Initial production of the Roxby Downs ore body would concentrate on high-grade gold areas. The Chairman acknowledged that the project had been granted development status by the Australian Labor Party and WMC is now in a position to pursue marketing discussions. No decision has been made on whether the uranium will be marketed jointly or separately. Although the company strongly reaffirmed its commitment to uranium mining and the Roxy Downs project in particular, it appears that a large-scale development will be delayed for some time unless a dramatic turnaround in the copper and uranium markets occurs. The recent focus on high-grade gold ores, however, could provide sufficient leverage to permit a smaller-scale operation to begin before 1990.

JAPAN

The Federation of Electric Power Companies (FEPC) continues to plan for the construction of enrichment, reprocessing, and low level waste storage facilities at a common location in the northern part of Japan's main island of Honshu (Report 193, September 1984). The FEPC has announced that a new company will be formed to own and operate the enrichment and waste storage facilities. The establishment of the company is scheduled for March 1985. Ownership will include the participation of approximately 50 nuclear-related companies centered around the nine private utilities in Japan.

Japan Nuclear Fuel Services (JNFS) will be responsible for construction and operation of the new facility for reprocessing of spent nuclear fuel. JNFS was organized by the utilities in 1980 for that purpose.

Report No. 194 updated the status of Japan utility nuclear power plants in operation, under construction, and planned. Since then, several units have made considerable progress. In October, Kansai Electric achieved criticality at its 870-MWe Takahama Unit 4 (PWR), and Tokyo Electric Power's (TEPCO) Fukushima Unit II-3, an 1100-MWe BWR, also achieved criticality. Commercial operation dates are August and July 1985 respectively. With successful operation of Takahama Unit 4, Kansai Electric will have approximately 3400-MWe capacity at its four-plant Takahama site. TEPCO also is proceeding with plans to license Kashiwazaki Units 3 and 4, both 1100-MWe BWRs. TEPCO will initiate license hearings in the near future and hopes to begin construction in 1987. TEPCO has scheduled commercial operation dates of July 1993 and July 1994.

Kyushu Electric has received license approval for its two 1180-MWe PWRs, Genkai Units 3 and 4. Construction on these units will start in the fall of 1985 with commercial operation scheduled for March 1993 and March 1994. Kyushu has also disclosed its intention to develop a third multiple plant site in addition to its Genkai (four PWRs) and Sendai (two PWRs) sites. Possible locations for new plants, which would not enter operation until the mid-1990s, are in the Saga and Nagasaki areas of Kyushu Electric's territory.

Also, Hokkaido Electric officially has begun construction of its twin 579-MWe PWR plants, Kyowa-Tomari Units 1 and 2.

UNITED STATES

Uranerz Exploration & Mining Ltd. of Canada and UNC Resources Inc. (UNC) have reached a settlement following countersuits filed over a disputed uranium supply contract. The two parties settled out of court several days before a jury trial was set to begin in federal court.

The supply contract, which UNC unilaterally abrogated early in 1984, was to have provided 2.3 million pounds U_3O_8 for delivery between 1984 and 1986. UNC cited "disagreements with the supplier" as the reason for the contract cancellation.

Trial on the countersuits was scheduled to begin on November 13. On November 8, in the US District Court for the Eastern District of Virginia at Alexandria, attorneys filed a motion to dismiss the case. Under the settlement UNC agreed to pay Uranerz $16.4 million.

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RAW MATERIALS

UPDATE—URANIUM RESOURCES IN SOUTH AFRICA

Introduction

The Nuclear Development Corporation (Pty) Ltd. (NUCOR) reevaluated uranium resources in South Africa in 1983. (See Report 193, page 25.) Reasonably Assured Resources (RAR) and Estimated Additional Resources (EAR)[1] based on an estimated production cost of US$30 per pound U_3O_8, are estimated at 343,000 tonnes U_3O_8, down about 14 percent from the 1981 estimate of 392,000 tonnes. The decrease is due primarily to reclassification of approximately 35,000 tonnes into a higher cost category, and a direct reduction of 14,000 tonnes produced in 1982 and 1983. Table 4 shows the distribution of resources among the five different host environments, including RAR and EAR classified in the $30–50/lb. U_3O_8 category.

The first four environments listed represent different geologic provinces where uranium occurs as an important constituent of a particular rock type; the fifth occurrence relates to unrecovered uranium contained in impounded gold slimes tailings accumulated during past gold recovery operations. Figure 12 is a map showing the geographic location of the uranium resource areas.

Uranium in the Witwatersrand conglomerate is produced from the gold/uranium mines located in five major mining areas of the Witwatersrand Basin. Uranium production from the area began in 1952, gradually increasing to 5,841 tonnes U_3O_8 in 1959 when 26 uranium-producing mines supplied ore for 17 recovery plants. Production reached an all-time high in 1980 when 21 mines supplying ore for 19 recovery plants produced 7,247 tonnes U_3O_8.

All uranium production in South Africa originated from Witwatersrand Basin mines until 1971. Presently, 97 percent of uranium produced in South Africa comes from the gold/uranium-bearing conglomerates, plus a small amount produced from reworked tailings within the Witwatersrand Basin. The remaining three percent is produced by the Palabora Mining Company Ltd. as a by-product to copper mining from the Palabora Igneous Complex located in the Letaba district, Northeastern Transvaal Lowveld. There is no production from the other resource areas, most of which remain to be fully evaluated.

Uranium Resources

Witwatersrand Conglomerates—The Witwatersrand sedimentary system of Early Proterozoic age is one of the world's major sources of gold and uranium. Gold was discovered in the quartz-pebble conglomerates of the system in 1886. Gold mining commenced immediately and progressed rapidly in the following years. Exploration and mining determined the existence of gold values in conglomeratic beds, called reefs, at different depths throughout the system. Continuity and correlation of reefs became important to continued property development within the basin. Total ore reserves today are estimated at more than one billion tonnes.

The occurrence of uranium in association with gold ores was first determined through evidence of radioactivity in the late 1880s. However, it was not until 1915 that the extent of the association in multi-occurring reefs was established; in 1923 the radioactive source was identified as uraninite, one of the most important uranium ore minerals. The Government Metallurgical Laboratory initiated studies focusing on the recovery of uranium from gold ores in the early 1940s. The first pilot recovery plant was successfully producing uranium concentrate in 1945. A second and larger pilot plant installed in the milling circuit of the Blyvooruitzicht gold mine in 1949 proved that commercial extraction was practical. A full-scale recovery plant began operating in late 1952.

Not all gold-bearing reefs contain uranium. Some 70 to 80 million tonnes of gold ore are uraniferous, containing approximately 0.20 pounds to over 2.00 pounds U_3O_8 per tonne. The feasibility of unmined ore reserves changes with the economics of either mineral, but primarily with gold. As the value of gold increases, additional lower grade ore may be considered minable; likewise, as gold values decrease, the lower grade ore becomes uneconomical. Uranium resources can change accordingly as illustrated by the shift of 35,000 tonnes recently reclassified into a higher cost category.

The sediments of the Witwatersrand system were deposited in a structural basin bounded on the northwest and southwest by faulting. Downwarping toward the basin center and to the southeast created the deepest section of the basin where sediments are approximately 7,600 meters thick. The important mines are located along the shallower northwest and southern tip of the basin. Present mining depths vary from 600 meters to over 3,700 meters.

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[1] Resource classification conforms with the NEA/IAEA definition. RAR includes uranium that occurs in known mineral deposits; EAR refers to uranium in addition to RAR that is expected to occur, based on geologic evidence.

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The Witwatersrand sequence was deposited unconformably on Archean basement rocks as a series of coarse sandstone units interbedded with siltstones and conglomerates. The irregular depositional sequence formed as fluvial fans, deltas, and channel fill. Gold and uranium mineralization are limited to certain conglomerate beds (reefs) in a 4,000-meter-thick section of the middle portion of Witwatersrand sediments.

Important mineralization is found in the matrix of conglomerates, in sand stringers containing moderate to heavy amounts of pyrite, along contact zones of shale and quartzitic beds, and in carbon/shale seams related to planes of unconformity. The minerals were transported as detrital particles deposited during the sedimentary sequence and are therefore syngenetic. However, there is evidence that certain occurrences, primarily gold in the shale and carbon environment, formed later as a result of chloride and cyanide-bearing solution, and biochemically through interaction between the gold (and uranium) and the algal or lichen colonies that developed along edges of channels and deltaic deposition.[2]

Reef systems containing gold and uranium mineralization of sufficient quantity and grade to be economically mined are confined to only 10 or 12 conglomeratic sequences. The lowest reefs include the Ada May (Beisa Reef) in the Orange Free State; the Carbon Leader of the

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[2] *Uranium in South Africa,* 1983 Assessment of Resources and Production, page 11, Nuclear Development Corporation of South Africa (Pty) Ltd.

Table 4

SOUTH AFRICA'S URANIUM RESOURCES IN THE RAR AND EAR-1 CATEGORIES[1] AS OF JANUARY 1, 1983

(Expressed in metric tons U_3O_8)

Principal Deposits or Districts	Reasonably Assured Resources (RAR)[2]		Estimated Additional Resources (EAR)[3]		Percent of Total
	$0–$30/lb. U_3O_8	$30–$50/lb. U_3O_8	$0–$30/lb. U_3O_8	$30–$50/lb. U_3O_8	
Witwatersrand Basin Conglomerates	192,000	59,000	116,000	51,000	77
Palabora	2,000	—	—	—	1
Karoo Sequence	5,000	59,000	1,000	6,000	12
Younger Surficial Sediments	—	1,000	—	—	1
Witwatersrand Basin Tailings	26,000	25,000	—	—	9
TOTAL RESOURCES	225,000	144,000	117,000	57,000	100

[1] Exploitable at costs of less than $50/lb. U_3O_8.

[2] Reasonably Assured Resources (RAR) refers to uranium that occurs in known mineral deposits of such size, grade and configuration that it could be recovered within the given production cost ranges with currently proven mining and processing technology. Estimates of tonnage and grade are based on specific sample data and measurements of the deposits and on knowledge of deposit characteristics. Reasonably Assured Resources have a high assurance of existence and in the cost category below $80/KgU are considered as *reserves* for the purposes of this table.

[3] Estimated Additional Resources-category 1 (EAR-1) refers to uranium in addition to RAR that is expected to occur, mostly on the basis of direct geological evidence in extensions of well-explored deposits and in deposits in which geological continuity has been established but where specific data and measurements of the deposits and knowledge of the deposits' characteristics are considered to be inadequate to classify the resource as RAR. Such deposits can be delineated and the uranium subsequently recovered, all within the given cost ranges. Estimates of tonnage and grade are based on such sampling as is available and on knowledge of the deposit characteristics as determined in the best-known parts of the deposit or in similar deposits. Less reliance can be placed on the estimates in this category than on those for RAR.

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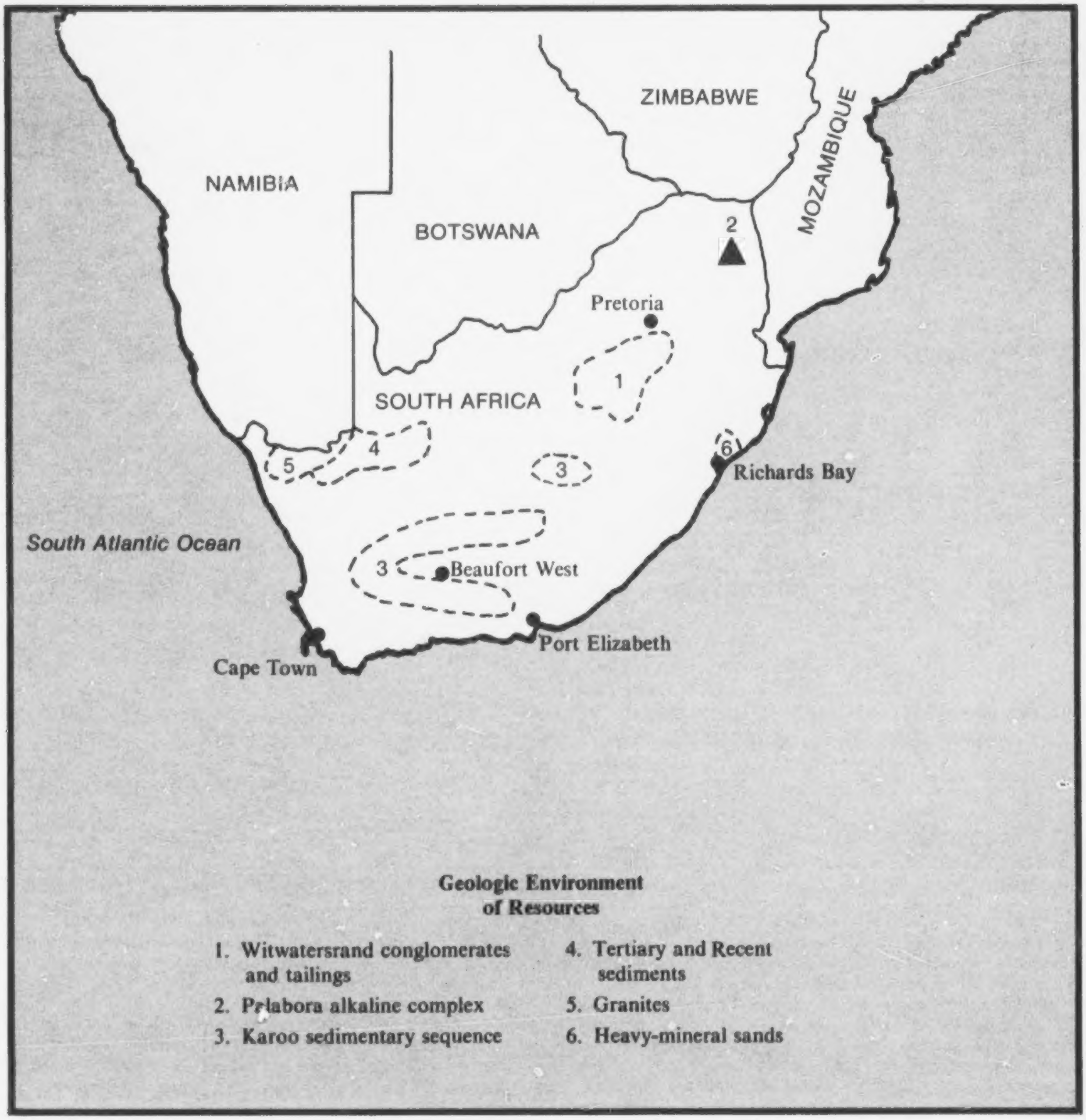
Figure 12

URANIUM RESOURCE LOCATION MAP OF SOUTH AFRICA


ZIMBABWE
NAMIBIA
MOZAMBIQUE
BOTSWANA
2
Pretoria
1
SOUTH AFRICA
4
5
6
3
Richards Bay
South Atlantic Ocean
3
Beaufort West
Port Elizabeth
Cape Town
Geologic Environment of Resources
1. Witwatersrand conglomerates and tailings
2. Palabora alkaline complex
3. Karoo sedimentary sequence
4. Tertiary and Recent sediments
5. Granites
6. Heavy-mineral sands

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Main Conglomerate Formation in the Central Rand; the White, Monarch and Bird Reefs on the West Rand; the Vaal Reef in the Klerksdorp Goldfield; the Basal and Leader Reefs in the Orange Free State Goldfield; and the Elsburg Reef in the Central Rand; and their equivalents, the A and B Reefs, in the Orange Free State. All reefs are being mined at present.

Witwatersrand Tailings—The 26,000 tonnes U_3O_8 contained in old mill tailings within the Witwatersrand Basin constitute the second largest uranium resource in South Africa. The uranium content in the slimes tailings averages about 0.10 percent U_3O_8 per tonne. Gold is the primary mineral recovered from the slimes. Uranium and pyrite are secondary minerals, but are important to project economics. The gold and part of the uranium are contained in the pyrite. Sulfuric acid produced from the pyrite is utilized in the uranium recovery process at each conventional recovery plant.

The recovery of minerals from the slimes begins with hydraulic sluicing of the large tailings piles. The slimes feed is passed through grinding ball mills with the exit slurry going to the leaching/cyanidation plant for gold recovery. The filtrate, which contains the uranium, is reslurried with an acidic solution and sent to the leach circuit. The uranium solution is removed by liquid/solid separation (counter current decantation). The pregnant solution is transferred to the solvent extraction circuit; ammonium sulfate is added and the uranium is extracted as ammonium diuranate slurry (ADU). The ADU is trucked to the Nuclear Fuels Corporation of South Africa (Pty) Ltd. (NUFCOR) plant for calcining and packaging.

Palabora Project—Copper mineralization was first noted in the alkaline rocks of the Palabora Igneous Complex in 1870. Eventually, exploration drilling and trenching established an ore reserve of over 100 million tonnes of low-grade copper. The Palabora Mining Company, Ltd. began mining copper ore from the central carbonatite core of the complex in 1964. The project is now one of the largest open-pit mine operations in the world.

The presence of uranium in association with the copper was first noted by the South African Atomic Energy Board in 1952. Uranium was produced as a by-product to copper in 1971 and, by the end of 1983, approximately 1,960 tonnes U_3O_8 were recovered. The rate of uranium production is geared to copper production. Presently, the annual recovery rate of uranium is 200 to 230 tonnes U_3O_8. Recoverable uranium resources at Palabora are estimated at 2,000 tonnes U_3O_8 contained in the remaining minable copper reserves. The source of uranium is the mineral uranothorianite, which occurs in close association with copper sulfide mineralization at an average grade of 0.0035 percent U_3O_8.

During the mineral recovery process, uranium concentrate is added to an acid leach and the uranium liquor transferred to a solvent extraction circuit. The uranium is stripped off in a counter-current mixer unit, followed by precipitation using ammonia gas. The final precipitated product is ammonium diuranate (ADU) slurry, which is then thickened and filtered on a rotary-drum vacuum filter. The filter cake is calcined and packaged for shipment.

Karoo Sediments—Uranium mineralization was first noted in lower Karoo sediments in 1967. The discovery set into motion a competitive exploration effort throughout the southern areas of South Africa. An important discovery was made in 1969 in Lower Beaufort sediments near the community of Beaufort West. Additional mineralization was located in sediments forming an east-west arc over a distance of 1,200 km in the southern Karoo Basin.

The important mineral occurrences are found in rocks of Permian and Triassic age. At least ten of 13 known mineral occurrences are in the Abrahamskraal and Teekloof Formations of the Adelaide Subgroup. The formations consist of interbedded sandstone and mudstone. Uranium mineralization is associated with a variety of depositional environments related to fluvial channeling, braided-stream and delta deposits, and terminal fans.

Mineralization is scattered throughout paleochannel trends as small, discontinuous pods measuring only a few meters in length; thickness varies greatly, reaching a maximum of about 7 meters in several instances. Carbonaceous debris is usually present in each ore pod. The carbonaceous debris and sharp depositional changes combine to create exploration guides to mineralization.

The main ore mineral is coffinite, occurring at grades of up to 0.45 percent U_3O_8; however, the average content of the 6,000-tonne resource is about 0.09 percent U_3O_8. Recoverable molybdenum usually is associated with the uranium, especially where carbon debris is abundant. Other minerals occurring in trace amounts include copper, gelena, zinc, manganese and phosphates. The deposits are not being mined, primarily due to their small size and the unfavorable market for uranium.

Tertiary and Recent Sediments—Small and widely scattered uranium occurrences have been recorded in Tertiary and Recent sediments throughout western South Africa. The potentially uranium-bearing formations were highly prospected in the mid-1970s by utilizing airborne

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radiometric detection devices. Most mineralization was discovered in paleochannels of the major river systems, usually in a calcrete environment, but occasionally in a diatomaceous earth deposit.

The main ore mineral associated with the calcrete is carnotite, found in the sand matrix and as an onion-skin coating on the larger sand grains. Uraninite is the main ore mineral closely associated with organic material in the diatomaceous earth. The average uranium content in deposits of this type is about 0.09 percent U_3O_8. Occurrences of this nature have not been exploited to date.

Miscellaneous Resources—Trace to low-grade amounts of uranium have been discovered in at least three other geologic environments of South Africa. The Springbok Flats coal deposit in the central Karoo Basin contains uranium at grades equivalent to the Karoo sediments. Uranium extraction from the coal has not been attempted on a commercial scale.

Low-grade mineralization has been evaluated in granitic and metamorphic rocks of the Namaqua/Natal belt in the northwestern Cape, in southern Natal and within the Bushveld Complex. The mineralization is disseminated well throughout the rocks, showing slight concentrations in highly fractured zones. Although the occurrences represent extremely large tonnages, each is well below commercial standards in the present condition of the market.

Large-tonnage, heavy-mineral sand deposits located north of Richards Bay on the east coast of South Africa contain monazite. The deposits are about 20 km long by 2 km wide, and contain several hundred million tonnes of mineral-bearing sand. The monazite is produced for export as a by-product of rutile production; however, none of the radioactive minerals are extracted during the rutile recovery operations.

Production Summary—Uranium production of 15.8 million pounds U_3O_8 in 1983 was the highest since 16.0 million pounds were produced in 1980. This increase was a result of a higher mining rate in eight gold/uranium mines in the Witwatersrand Basin, with the greatest increases occurring in the St. Helena-Beisa Section and Western Areas. Driefontein Consolidated showed the largest drop in production. The depletion of surface slimes processed through late 1983 reduced production by more than 22 percent from the 1982 level. In addition, production at Joint Metallurgical Scheme dropped 16 percent.

Since South African uranium production is primarily committed to long-term sales contracts, uranium price variations do not overly influence production schedules. Prices under longer-term contracts tend to fluctuate well above spot market prices. Moreover, despite low gold and uranium prices in the international markets, uranium/gold operations continued to prosper, and a uranium production level coincident to gold production probably will be maintained. (By-product and co-product uranium production from gold mining generally costs less than primary uranium production.) NUCOR projects annual production to be in the range of 15.5 million pounds U_3O_8 to 17 million pounds U_3O_8 through 1995. South Africa will continue to be one of the world's most reliable uranium-producing countries.

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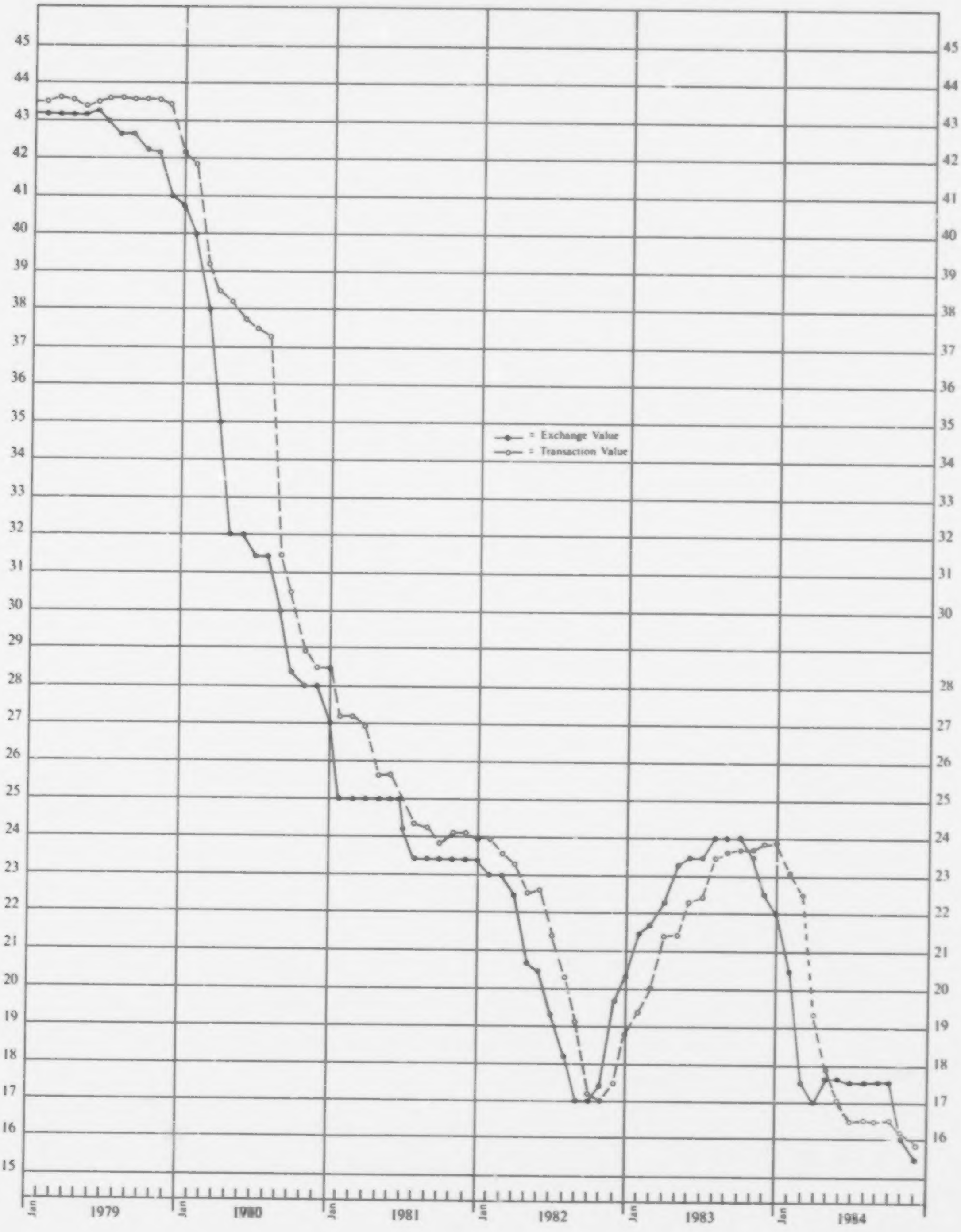
EXCHANGE AND TRANSACTION VALUES
SINCE JANUARY 1979

Determined as of the last day of the month indicated



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HISTORICAL MARKET DATA

HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	—	—	—	—	—	—	—	6.35	6.35	6.40	6.45	6.50
1969	—	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	32.50	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00
1981	25.00	25.00	25.00	25.00	25.00	24.25	23.50	23.50	23.50	23.50	23.50	23.50
1982	23.00	23.00	22.50	20.75	20.50	19.25	18.25	17.00	17.00	17.50	19.75	20.25
1983	21.50	21.75	22.25	23.25	23.50	23.50	24.00	24.00	24.00	23.50	22.50	22.00
1984	20.50	17.50	17.00	17.75	17.75	17.50	17.50	17.50	17.50	16.00	**15.50**	

HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	—	—	—	—	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38.40	37.90	37.60	37.30	31.60	30.60	29.00	28.70	27.70
1981	27.20	27.20	27.00	25.70	25.70	24.50	24.40	24.30	23.90	24.10	24.10	24.00
1982	24.00	23.70	23.40	22.60	22.70	21.50	20.30	19.10	17.30	17.00	17.55	18.80
1983	19.35	20.00	21.35	21.40	22.35	22.45	23.50	23.60	23.65	23.65	23.85	23.85
1984	23.05	22.50	19.25	17.90	17.00	16.50	16.60	16.40	16.55	16.05	**15.90**	

HISTORICAL CONVERSION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U as UF_6)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	1.20	1.20	1.20	1.40	1.15	1.15	1.15	1.10	1.10	1.10	1.20	1.20
1982	1.20	1.20	1.20	1.20	1.00	1.00	1.00	0.90	1.10	1.60	1.45	1.45
1983	1.20	1.40	1.40	1.20	1.20	1.20	1.10	1.10	1.00	0.60	0.60	0.60
1984	0.60	0.30	0.80	0.80	0.80	0.00	0.00	0.80	1.00	1.00	**0.80**	

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AUSTRALIA

	Price Index of Materials Used in Manufacturing Industry—All Groups[1] (1969=100)	Award Rates of Pay Indexes Australia—Adult Males In Mining Wage and Salary Earners, Weekly Rates[2] (1976=100)
1983 Avg.	401.2	181.8
Aug 1983	403.0	180.7
Sep 1983	402.9	180.6
Oct 1983	397.5	188.3
Nov 1983	395.5	188.3
Dec 1983	399.2	188.1
Jan 1984	399.2R	188.6R
Feb 1984	402.5R	188.5R
Mar 1984	403.9R	188.3R
Apr 1984	404.2R	196.2R
May 1984	403.8R	196.9R
Jun 1984	404.9R	196.9R
Jul 1984	408.5R	196.9R
Aug 1984	413.3R	196.9R
Sep 1984	412.1	196.9

P = Preliminary R = Revised since last month

CANADA

	Industry Selling Price Index: Manufacturing[1] (1971=100)	Wage-earner Data: Average Hourly Earnings (C$)[2]					
		Uranium Mines (SIC 057)	Metal Mines* (SIC 051-059)	Mines, Quarries and Oil Wells[3] (SIC 051-099)	Primary Metal Industries Non-ferrous[4]		Chemicals and Chemical Products[5] (SIC 372-379)
					(SIC 296)	(SIC 298)	
1983 Avg.	298.8	—	—**	14.30	—	—	11.17
Sep 1983	301.1	17.66	14.90	14.41	11.99	10.32	11.29
Oct 1983	301.6	17.73	15.27	14.65	11.76	10.03	11.30
Nov 1983	301.8	17.82	15.29	14.67	11.78	10.62	11.38
Dec 1983	302.9	17.84	15.11	14.66	11.86	10.60	11.51
Jan 1984	305.4	17.74	15.27	14.74	11.91	10.84	11.69
Feb 1984	306.6	17.78	15.59	14.90	12.04	10.82	11.51
Mar 1984	308.7	18.05	15.52	14.82	12.14	10.84	11.58
Apr 1984	310.5	18.06	15.83	15.10	11.96	10.34	11.63
May 1984	310.6	18.48	15.64	15.06	12.11	10.16	11.65
Jun 1984	311.0	18.08	15.48	14.80	12.38	10.40	11.66
Jul 1984	312.8R	17.81	15.72	14.92	12.53	10.18	11.82
Aug 1984	312.4R	17.24	15.36R	14.92R	12.44R	10.34R	11.78R
Sep 1984	312.0	17.66P	15.64P	15.13P	12.47P	10.54P	11.95P
Oct 1984	312.1P	—	—	—	—	—	—

P = Preliminary R = Revised since last month

For annual averages prior to 1983, and for notes pertaining to these statistics, see pages 23-26 of Report 190 of June 1984.

*The 1980 average for Metal Mines was incorrectly reported as 10.59. The correct average is 10.58 (see Report 190).

**Two different methods were used in the 1983 "Metal Mines" category in reporting survey data, and Statistics Canada did not publish a 1983 average. The March 1983 figure for the old method was 14.73 and for the new method was 14.84. The published average for 1983 in Report 190 was a Nuexco calculation based on the available monthly statistics for 1983 with the exception of the March figure, where only the 14.84 value was taken into account.

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GOVERNMENT STATISTICS

REPUBLIC OF SOUTH AFRICA

	Average Declared Working Costs per per Metric Ton of Gold Ore Milled (Rand)[1]	Tonnage-Weighted Index of Average Working Costs per Metric Ton of Gold Ore Milled (March 1982=100)[2]	Consumer Price Index[3] (1975=100)[4]	Producer Price Index All Groups[5] (1975=100)	Total Employment in Mining and Quarrying (Code 35)[6]	Total Salaries and Wages in Mining and Quarrying (1,000 Rand) (Code 40)[6]
1983 Avg.	51.87	115.0	262.2	274.8	696,579	3,644,772
Aug 1983	—	—	265.6	278.9	698,984	311,789
Sep 1983	52.92	117.4	267.3	279.4	696,435	312,264
Oct 1983	—	—	270.0	281.0	693,225	311,418
Nov 1983	—	—	271.4	281.6	688,459	317,485
Dec 1983	53.70	119.6	273.2	283.7	690,750	333,595
Jan 1984	—	—	274.7	283.3	689,807	326,619
Feb 1984	—	—	278.4	286.5	702,553	335,906
Mar 1984	55.30	123.1	281.9	288.0	715,628	342,332
Apr 1984	—	—	286.1	290.2	712,963	327,550
May 1984	—	—	288.3	292.6	710,040	327,937
Jun 1984	56.95	126.2	291.2	295.3	717,009	347,121
Jul 1984	—	—	295.1	296.0	717,121	369,964
Aug 1984	—	—	297.0	300.8	721,905	361,357
Sep 1984	60.64R	133.2	299.9	304.1	—	—
Oct 1984	—	—	303.7	—	—	—

UNITED STATES

	Producer Price Index[1]		Consumer Price Index[2]	GNP Implicit Price Deflator[3]	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[4]			
	Industrial Commodities (1967=100)	All Commodities (1967=100)	(1967=100)	(1972=100)	Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)	Electric and Electronic Equipment (SIC 36)
1983 Avg.	315.8	303.1	298.4	215.63	12.57	13.43	10.59	8.65
Aug 1983	317.3	304.7	300.3	—	12.54	13.46	10.62	8.62
Sep 1983	317.1	305.3	301.8	216.44	12.62	13.46	10.70	8.73
Oct 1983	318.5	306.0	302.6	—	12.67	13.55	10.79	8.71
Nov 1983	318.3	305.5	303.1	—	12.64	13.56	10.86	8.77
Dec 1983	318.4	306.1	303.5	218.53	12.75	13.33	10.90	8.84
Jan 1984	319.1	308.0	305.2	—	12.67	13.38	10.91	8.88
Feb 1984	320.6	308.9	306.6	—	12.81	13.34	10.90	8.86
Mar 1984	321.9	311.0	307.3	220.58	12.85	13.33	10.95	8.88
Apr 1984	322.5	311.4	308.8	—	12.91	13.30	10.97	8.89
May 1984	323.3	311.7	309.7	—	12.99	13.37	11.02	8.89
Jun 1984	323.9	311.4	310.7	222.40	12.96	13.40	11.03	8.91
Jul 1984	324.0	312.0	311.7	—	13.02	13.36	11.12	8.95
Aug 1984	323.5	310.9	313.0	—	13.10R	13.51R	11.13R	9.00
Sep 1984	322.3	309.5	314.5	224.36	13.23P	13.40P	11.24R	9.08
Oct 1984	323.2	309.4	315.3	—	—	—	11.27P	9.09P

P = Preliminary R = Revised since last month

For annual averages prior to 1983, and for notes pertaining to these statistics, see pages 23-26 of Report 190 of June 1984.

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NUEXCO

EXECUTIVE SUMMARY
REPORT 196
(All data as of November 30, 1984)

Exchange Value **\$15.50, down \$0.50**	The **Exchange Value** is **\$15.50** per pound U_3O_8, down \$0.50 since last month. Three recent uranium sales are reported, involving approximately 10 million pounds U_3O_8 equivalent. All were sales of natural UF_6; two involved deliveries prior to 1986, and one met the conditions for inclusion in the Transaction Value.
Supply-Demand Ratio **fell to 4.0:1**	Active spot and near-term **uranium supply** amounts to **5.2 million** pounds U_3O_8 equivalent, down 200 thousand pounds since last month. Active spot and near-term **uranium demand** totals **1.3 million** pounds, up 35 thousand pounds. The spot and near-term **supply-demand ratio** declined to **4.0:1.**
Transaction Value **fell \$0.15, to \$15.90**	The **Transaction Value** is **\$15.90** per pound U_3O_8, down \$0.15 since last month. The calculation includes 11 transactions involving a total of 3.5 million pounds U_3O_8 and equivalent UF_6, and covers a period of 6 months.
Loan Use Charge Rate **unchanged at 6%**	The **Loan Use Charge Rate** remains **6 percent** per annum in a dormant market.
Conversion Value **fell to \$0.80**	The **Conversion Value** is **\$0.80** per pound U as UF_6, down \$0.20 since last month. No secondary market conversion transactions are reported. Active secondary market supply of conversion services for delivery within three years totals 1.2 million pounds U as UF_6. No active demand is reported.
SWU Values: **\$115 for DOE-origin (FY85)** **\$15 discount for FY86** **\$85 for non-DOE origin (delivery within 15 months)** **\$95 for calendar year 1986**	The **SWU Values** are **\$115** per SWU of DOE origin certifiable as excess and FY85 delivery, at .3 tails, and **\$15** per SWU discount from DOE base price for FY86 delivery (at .3 tails). SWU Values for other SWUs (non-DOE or non-certifiable) are **\$85** per SWU for delivery within 15 months, and **\$95** per SWU for calendar year 1986. Seven secondary market SWU transactions are reported, involving 370 thousand SWUs. Active secondary market SWU supply amounts to 475 thousand SWUs, while active demand totals 125 thousand SWUs.
Pricing	In an article entitled "DOE: Business or Government Service?", Nuexco CEO J. R. Wolcott reflects on some of DOE's recent actions.
Analysis & Commentary	The second in a series of three articles on the concepts and applications of the optimum tails assay demonstrates how the tails assay for minimum product cost changes when the unit price of SWU is dependent on the tails assay.
Focus	Sweden's ten operating reactors and development of nuclear technologies have propelled it to a position of leadership in the use of nuclear energy.
Australia	The Chairman of Western Mining Corp. indicated that full production of Roxby Downs would be achieved in stages, and initial production of the project would focus on high-grade gold areas.
Japan	The Federation of Electric Power Companies continues to plan for the construction of enrichment, reprocessing, and waste storage facilities on the island of Honshu.
United States	Uranerz Exploration & Mining and UNC Resources have settled out of court in a dispute over a canceled uranium supply contract several days before a jury trial was to begin.
Raw Materials	Uranium resources in South Africa occur in five different environments, and are often associated with gold, pyrite, or copper mineralization.

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NUEXCO

NUEXCO REPORT 196 FIGURES OF THE MONTH (November 30, 1984)	This Month (Report 196)	Last Month (Report 195)	12 Months Ago (Report 184)
Exchange Value[1]	15.50	16.00	22.50
Transaction Value[1]	15.90	16.05	23.85
Loan Use Charge Rate[2]	6%	6%	6%
Conversion Value[3]	0.80	1.00	0.60
Near-Term Uranium Supply[4]	5.2	5.5	5.7
Near-Term Uranium Demand[5]	1.3	1.3	3.1
Near-Term Supply-Demand Ratio	4.0	4.3	1.8
Recent Uranium Sales:			
Number of Transactions[6]	3	11	5
Quantity of Material[7]	9.8	1.6	6.2
Nuexco SWU Values:[8]			
DOE origin, certifiable as excess, 0.3 tails assay			
FY85 delivery	115	115	—
FY86 delivery	15[9]	20[9]	—
Other SWUs (non-DOE or non-certifiable)			
delivery within 15 months	85	90	—
delivery for calendar year 1986	95	98	—
USDOE SWU Prices:			
USEC	135.00	135.00	—
AFC	153.00[10]	153.00[10]	138.65
Requirements	157.00[10]	157.00[10]	149.85
Market Value of Enriched UF_6[11] [12]:			
2.5 w/o U_{235}	518	528	693
3.0 w/o U_{235}	671	683	896
3.5 w/o U_{235}	828	842	1,103
4.0 w/o U_{235}	987	1,003	1,313

---

[1] US $ per pound U_3O_8 equivalent.

[2] Per annum.

[3] US $ per pound U as UF_6.

[4] Active inquiries to sell, for delivery within 12 months after contract signing (millions of pounds U_3O_8).

[5] Active inquiries to purchase, for delivery within 12 months after contract signing (millions of pounds U_3O_8).

[6] Uranium sales only; does not include loans, conversion, or SWU transactions.

[7] Millions of pounds U_3O_8, equivalent.

[8] US $ per SWU.

[9] Discount from USEC base price on delivery.

[10] Effective 10/1/84.

[11] Calculated using the Nuexco Exchange Value, Conversion Value, and 0.30 percent tails assay. From 10/31/83 through 2/29/84, calculations used the Nuexco SWU Value for DOE origin and FY84 delivery. As of 3/31/84, calculations use the Nuexco SWU Value for DOE origin and FY85 delivery.

[12] US $ per KgU as UF_6, rounded to the nearest $.

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NUEXCO

JANUARY 1985 NUMBER 197

MONTHLY REPORT

ON THE NUCLEAR FUEL MARKET

NUEXCO

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NUEXCO

MONTHLY REPORT ON THE NUCLEAR FUEL MARKET

January 1985 No. 197

R. WESLEY MILLER, *EDITOR* CLARK M. BEYER, *ASSOCIATE EDITOR*

PRICING

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NUEXCO

To Our Readers

Jerry Reaves

We are pleased to announce that Mr. **Jerry Reaves**, Vice President at our Southeast United States office, is now in charge of US and Far East brokerage operations. Jerry has assumed the position vacated by Wayne Fowler, who was named President effective December 1, 1984. Jerry will be responsible for the coordination of all brokerage activities in our US offices in addition to his current administrative duties.

* * *

Dick Andersen will be leaving Nuexco on January 11 to join Management Analysis Company in San Diego. We wish him good luck in his new pursuit.

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NUEXCO

NATURAL URANIUM AND SECONDARY MARKET CONVERSION

The **Exchange Value** as of December 31, 1984 is **$15.25** per pound U_3O_8, down $0.25 since last month. **Active supply** of natural uranium (U_3O_8 and UF_6) for spot or near-term delivery totals **3,640,000** pounds U_3O_8 or equivalent UF_6, down 1,600,000 pounds since last month. The corresponding figure for **active demand** is **1,250,000** pounds, down 60,000 pounds. The spot and near-term **supply-demand ratio** fell to **2.9:1.**

The *Current Market Data* section of this Report lists seven uranium sales transactions, involving a total of approximately 2,600,000 pounds equivalent U_3O_8. Six of the transactions reported this month involved deliveries before 1986, and five met the criteria for inclusion in the current Transaction Value calculation. One transaction is not current, in that it was concluded in mid-1984.

The **Transaction Value** as of December 31, 1984 is **$15.90** per pound U_3O_8, unchanged since last month. The current Transaction Value includes 16 transactions involving a total of 3.7 million pounds U_3O_8 or equivalent UF_6 and covers a period of 7 months.

The **Loan Use Charge Rate** as of December 31, 1984 is **6 percent** per annum, unchanged since last month in a dormant market.

* * *

The Exchange Value declined for the third month in a row as supply of natural uranium concentrates continued to exceed the highly discretionary demand. Increased competition between sellers for the few available opportunities forced the price of uranium down, as at least two transactions were concluded at or below the $15.50 level. Moreover, substantial quantities of natural uranium and UF_6 at the $15.50 price level failed to attract great interest. Of the few buyers in need of immediate delivery of material, most have failed to respond to offers in the $15.50 to $16.00 range.

The supply-demand ratio declined somewhat in December due to inventory clearances on the part of some sellers. Nevertheless, substantial quantities of material remain available, a condition which could apply continued downward pressure on spot and near-term delivery prices in the coming months.

Although five new transactions entered the Transaction Value calculation, the collective quantity was low enough to require the presence of the previous six months' transactions in the calculation in order to meet the required 2,000,000-pound minimum. Thus the recent transactions, despite the prices involved, have not yet begun to influence the Transaction Value significantly.

* * *

The **Conversion Value** is **$0.80** per pound U in UF_6, unchanged since last month. One secondary market conversion transaction is reported, involving approximately 275,000 pounds U in UF_6. Active supply of secondary market conversion services for delivery within three years fell slightly, to 1,000,000 pounds U in UF_6, as one supplier withdrew from the market. No active secondary market conversion demand is reported.

ENRICHED URANIUM AND SWUS

The Nuexco **SWU Values** as of December 31, 1984 are:

1. For **DOE origin,** a tails assay of 0.30 weight-percent U_{235}, and certifiable as excess:
   a. For FY85 delivery, $112 per SWU, down $3;
   b. For FY86 delivery, $15 discount from the USEC base price on delivery, unchanged;
2. For **other** SWUs (includes DOE origin SWUs not certifiable as excess and non-DOE origin SWUs):
   a. For delivery within approximately 15 months, $80 per SWU, down $5;
   b. For delivery in mid-to-late calendar year 1986, $90 per SWU, down $5.

Two secondary market SWU transactions are reported, involving approximately 90,000 SWUs. One transaction was of DOE origin, and one was of Eurodif origin.

* * *

The market for DOE origin SWUs certifiable as excess for FY85 delivery continues to disappear as most FY85 SWU buyers have made commitments, although small amounts of material should be available for a few more months. The demand for FY85 deliveries has largely been filled, and few buyers are actively soliciting offers. The entry of a new seller with significant quantities of FY85 SWUs forced the price down slightly in the absence of new demand. Many buyers are now focusing on the FY86 market, and with the presence of increasing demand, the activity is increasing. However, at this early date for FY86 SWUs certifiable as excess, there is still wide price disparity between sellers and buyers.

DOE customers exhibit little demand for SWUs that are either non-DOE origin or are not certifiable as excess. Most utilities not covered by the USEC have already purchased or are in negotiation, while those covered by the USEC are not allowed to fulfill SWU requirements from sources other than DOE until 1987. Thus, new deals for other SWUs are difficult to find at present. The demand in Europe for non-DOE SWUs has fallen considerably, bringing the prices down as some suppliers begin to compete for the few opportunities.

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CURRENT MARKET DATA

December 31, 1984	Market Values	Active Supply[1] (thousands)	Active Demand[1] (thousands)
EXCHANGE VALUE	**$15.25**/lb. U_3O_8	3,640	1,250
CONVERSION VALUE	**$0.80**/lb. U in UF_6	1,000	0
SWU VALUES			
DOE origin, certifiable as excess, 0.3 tails assay			
FY85 delivery	**$112**/SWU		
FY86 delivery	**$15** discount/SWU		
Other SWUs (non-DOE or non-certifiable)			
delivery within 15 months	**$80**/SWU		
delivery for mid-to-late calendar year 1986	**$90**/SWU		
LOAN USE CHARGE RATE	**6%**/annum	0	0

TRANSACTION VALUE

$/lb. U_3O_8	Millions of Pounds	Number of Transactions	Number of Months
15.90	3.7	16	7

DEFINITIONS

1. The **Exchange Value** is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the date indicated.
2. The **Conversion Value** is Nuexco's judgment of the price at which spot and near-term transactions for significant quantities of conversion services could be concluded in the secondary market as of the date indicated.
3. The **SWU Values** represent Nuexco's judgment of the price at which transactions for the sale of significant quantities of SWUs of stated origin for delivery in the specified time period could be concluded as of the date indicated.
4. The **Loan Use Charge Rate** is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the date indicated.
5. The **Transaction Value** is a weighted average price of recent natural uranium sales transactions. The calculation is based on prices paid in:
   a. Transactions closed within the previous three-month period for which delivery is scheduled within one year of the transaction date;
   b. At least ten transactions;
   c. Transactions involving a sum total of at least 2 million pounds U_3O_8 equivalent.

   The sample time is extended as necessary to include these minima. Other currencies are converted to US dollars using conversion rates in effect on or near the transaction date.

DERIVATIONS AND COMMENTS

1. All Market Values are based on:
   a. Data from recently completed transactions.
   b. Data from pending transactions.
   c. Firm bids to buy or borrow, and firm offers to sell or lend.
   d. Prices purchasers or rates borrowers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy or borrow, and prices sellers or rates lenders have expressed a willingness to offer, but for which Nuexco is not aware of firm offers to sell or lend.
2. Prices associated with deliveries under old or renegotiated contracts or other than arm's-length transactions are not considered in the determination of these Market Values.
3. In the determination of the Conversion Value, Nuexco does not consider transportation charges other than those customarily provided by primary suppliers of conversion services.
4. The prices of conversion services or SWUs delivered under long-term contracts with primary suppliers are not considered in the determination of either the Conversion Value or SWU Value.
5. For the DOE SWU Values, Nuexco converts SWU prices at varying tails and product assays to equivalent SWU prices at a tails assay of 0.30 weight-percent U_{235} and a product assay of 3.0 weight-percent U_{235}, assuming feed costs corresponding to the Nuexco Exchange and Conversion Values determined as of the same date.
6. In calculating the Transaction Value, Nuexco does not account for the price of uranium delivered in connection with contracts which call for "market price" mechanisms. This exclusion applies particularly to contracts in which delivery prices are expressed as a function of future Exchange Values or any other indeterminant variable. Also excluded from the calculation are any other transactions in which the delivery price is defined in such a way that it cannot currently be determined.

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[1] Supply and demand tables in the *Current Market Data* section of this Report detail the numbers for each category. Quantities of SWUs (Separative Work Units) are not referenced to a particular origin.

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CURRENT MARKET DATA

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb. U_3O_8 in Concentrates			per kg. U in Concentrates		
	This Month (Dec. 31, 1984)	Last Month (Nov. 30, 1984)	12 Months Ago (Dec. 31, 1983)	This Month (Dec. 31, 1984)	Last Month (Nov. 30, 1984)	12 Months Ago (Dec. 31, 1983)
Australia (dollar)	18.37	17.99	24.50	47.77	46.77	63.69
Belgium (comm. franc)	960.33	959.16	1,226	2,497	2,494	3,186
Canada (dollar)	20.13	20.49	27.38	52.34	53.27	71.19
Finland (markka)	99.48	99.17	128.21	258.62	257.82	333.30
France (franc)	147.20	145.95	183.49	382.69	379.44	477.02
FRG (mark)	47.99	47.74	59.96	124.75	124.10	155.89
Italy (lira)	29,480	29,451	36,545	76,641	76,566	95,008
Japan (yen)	3,814	3,811	5,106	9,917	9,908	13,273
Netherlands (guilder)	54.08	53.65	67.46	140.59	139.48	175.39
South Africa (rand)	29.99	28.62	26.80	77.97	74.42	69.67
Spain (peseta)	2,638	2,663	3,466	6,857	6,923	9,011
Sweden (krona)	136.53	135.85	176.14	354.94	353.17	457.93
Switzerland (franc)	39.54	39.17	47.98	102.79	101.84	124.74
UK (pound)	13.10	12.88	15.19	34.05	33.50	39.50
US (dollar)	15.25	15.50	22.00	39.65	40.30	57.20

TRANSACTION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb. U_3O_8 in Concentrates			per kg. U in Concentrates		
	This Month (Dec. 31, 1984)	Last Month (Nov. 30, 1984)	12 Months Ago (Dec. 31, 1983)	This Month (Dec. 31, 1984)	Last Month (Nov. 30, 1984)	12 Months Ago (Dec. 31, 1983)
Australia (dollar)	19.16	18.46	26.56	49.80	47.98	69.05
Belgium (comm. franc)	1,001	983.91	1,329	2,603	2,558	3,454
Canada (dollar)	20.99	21.02	29.69	54.57	54.65	77.18
Finland (markka)	103.72	101.73	138.99	269.64	264.47	361.33
France (franc)	153.47	149.72	198.92	399.00	389.23	517.14
FRG (mark)	50.03	48.97	65.00	130.07	127.31	169.00
Italy (lira)	30,737	30,211	39,618	79,908	78,542	102,998
Japan (yen)	3,977	3,910	5,535	10,339	10,164	14,390
Netherlands (guilder)	56.38	55.04	73.14	146.58	143.08	190.14
South Africa (rand)	31.27	29.36	29.05	81.29	76.34	75.52
Spain (peseta)	2,750	2,731	3,758	7,149	7,101	9,769
Sweden (krona)	142.35	139.35	190.95	370.07	362.28	496.43
Switzerland (franc)	41.22	40.18	52.02	107.17	104.46	135.23
UK (pound)	13.65	13.22	16.47	35.50	34.36	42.82
US (dollar)	15.90	15.90	23.85	41.34	41.34	62.00

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[1] Calculated using currency exchange rates published in the *Wall Street Journal* on December 28, 1984.

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CURRENT MARKET DATA

CONVERSION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb. U as UF_6 This Month (Dec. 31, 1984)	per lb. U as UF_6 Last Month (Nov. 30, 1984)	per lb. U as UF_6 12 Months Ago (Dec. 31, 1983)	per kg. U as UF_6 This Month (Dec. 31, 1984)	per kg. U as UF_6 Last Month (Nov. 30, 1984)	per kg. U as UF_6 12 Months Ago (Dec. 31, 1983)
Australia (dollar)	0.96	0.93	0.67	2.13	2.05	1.47
Belgium (comm. franc)	50.38	49.51	33.43	111.06	109.14	73.69
Canada (dollar)	1.06	1.06	0.75	2.33	2.33	1.65
Finland (markka)	5.22	5.12	3.50	11.50	11.28	7.71
France (franc)	7.72	7.53	5.00	17.02	16.61	11.03
FRG (mark)	2.52	2.46	1.64	5.55	5.43	3.61
Italy (lira)	1,546	1,520	996.68	3,409	3,351	2,197
Japan (yen)	200.10	196.71	139.24	441.14	433.66	306.98
Netherlands (guilder)	2.84	2.77	1.84	6.25	6.10	4.06
South Africa (rand)	1.57	1.48	0.73	3.47	3.26	1.61
Spain (peseta)	138.36	137.43	94.53	305.03	302.99	208.41
Sweden (krona)	7.16	7.01	4.80	15.79	15.46	10.59
Switzerland (franc)	2.07	2.02	1.31	4.57	4.46	2.89
UK (pound)	0.69	0.67	0.41	1.51	1.47	0.91
US (dollar)	0.80	0.80	0.60	1.76	1.76	1.32

SWU VALUES EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	DOE SWU FY85 (December 31, 1984)	Non-DOE SWU delivery within 15 months (December 31, 1984)	Non-DOE SWU calendar year 1986 (December 31, 1984)
Australia (dollar)	134.94	96.39	108.43
Belgium (comm. franc)	7,053	5,038	5,668
Canada (dollar)	147.85	105.61	118.81
Finland (markka)	730.59	521.85	587.08
France (franc)	1,081	772.20	868.73
FRG (mark)	352.42	251.73	283.20
Italy (lira)	216,509	154,649	173,980
Japan (yen)	28,014	20,010	22,511
Netherlands (guilder)	397.16	283.69	319.15
South Africa (rand)	220.26	157.33	176.99
Spain (peseta)	19,370	13,836	15,566
Sweden (krona)	1,003	716.20	805.73
Switzerland (franc)	290.38	207.42	233.34
UK (pound)	96.18	68.70	77.29
US (dollar)	112.00	80.00	90.00

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[1] Calculated using currency exchange rates published in the *Wall Street Journal* on December 28, 1984.

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CURRENT MARKET DATA

RECENT TRANSACTIONS[1]

Uranium Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U_3O_8 equivalent)	Approximate Price as Percent of Current E.V.	Seller	Buyer	Remarks
3241	1985	less than 50	107	European Producer	Broker	
3240	1985	less than 50	103	US Producer	Broker	
3232	1985	less than 50	102	US Producer	US Producer	
3231	1984	601-1,000	R[2]	European Utility	European Utility	Not an arm's length transaction. Occurred in mid-1984.
3230	1985	50-100	106	Broker	US Utility	
3229	1984-1985	101-300	101	US Producer	US Utility	
3228	1991-1996	1,001-1,500	see remarks	Australian Producer	US Utility	Market related; dependent on floor price.

[1] Transactions listed are not limited to those in which Nuexco was involved, but also include others of which Nuexco is aware.
[2] The notation *R* means that Nuexco either does not know, or that Nuexco has restricted that information to protect client confidentiality.

Secondary Market Conversion Services

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U equivalent)	Approximate Price as Percent of Current C.V.	Seller	Buyer	Remarks
3245	1985	101-300	63	US Producer	US Utility	Not an arm's length transaction.

Enrichment Services
Secondary Market Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity[2] (thousands of SWUs)	Approximate Price[3] as Percent of Current SWU Value[4]	Seller Group	Buyer Group	SWU Origin	Remarks
3247	1985	less than 50	103	US Utility	US Utility	DOE	Sold from LEU inventory.
3248	1985-1986	50-100	78-88	European Entity	European Entity	Eurodif	

[1] Transactions listed are not limited to those in which Nuexco was involved, but also include others of which Nuexco is aware.
[2] If tails assay is unknown or unspecified, Nuexco's calculation of SWU quantity assumes 0.30 w/o tails assay.
[3] Price is not normalized to 0.30% tails assay.
[4] Refers to SWU Value that corresponds to SWUs included in transaction. When prices and SWU values are expressed as discounts (e.g., X dollars less than DOE's USEC base price at time of delivery), the percentage refers to the ratio of the *discounts*, not the ratio of the prices.

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CURRENT MARKET DATA

URANIUM SUPPLY
(December 31, 1984)

	Delivery Period[1] (Thousands of Pounds U_3O_8)		
Nuexco Project Number	**Spot or Near-term[2]**	**Intermediate or Long-term**	**Remarks**
Available for Sale:			
ACTIVE			
1575	500	500 per year	
1860	400	1,500 per year	
2038	1,000	1,000 per year	UF_6
2288A	40	—	
2288B	295	—	UF_6
2389*	300	—	
2392	35	—	UF_6
2499	15	—	
2516	200	—	
2538*	55	—	
2565	400	—	
2569*	200	—	
2584*	200	—	
2134	—	220 per year	1985-87
2236*	—	200 per year	1985-89
2263	—	500 per year	1985-90
2625*	—	300 per year	1988-97
2654	—	1,050	1985-87
TOTAL:	3,640		
INACTIVE			
2191	125	—	UF_6
2275	150	—	
2335	275	—	
2336*	250	250 per year	1985-94
2495	130	—	UF_6
2509	1,200	1,600	UF_6
2553	300	—	
0564	—	1,000 per year	1985-90
2271*	—	500 per year	1985-88
2297	—	200 per year	1986-89
2326	—	1,000 per year	1989-91
2368	—	250 per year	1987-90
2473*	—	500 per year	1985-90
2514	—	1,000 per year	
2574	—	500	UF_6
TOTAL:	2,430		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2541, 2588, 2648.

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URANIUM DEMAND
(December 31, 1984)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Spot or Near-term[2]	Delivery Period[1] (Thousands of Pounds U_3O_8) Intermediate or Long-term	Remarks
Inquiries to Purchase:			
ACTIVE			
2419B	60	—	UF_6
2533	300	—	
2548	300	—	
2590	475	—	U_3O_8 or UF_6
2217	—	1,000 per year	1989-95
2442	—	4,000	1986-95
2507	—	600	1987-89
2540	—	400 per year	1989-94
TOTAL:	1,250		
INACTIVE			
2329	500	—	1985
2576	20	—	UF_6
2638*	325	325	UF_6
1999*	—	50 per year	1986-90
2244	—	350 per year	1987 on
2414	—	150 per year	1987-91
2457	—	350 per year	1988 on
2586*	—	300	1987
2643*	—	150 per year	1987 on
TOTAL:	845		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2539, 2555, 2568.

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CURRENT MARKET DATA

CONVERSION SUPPLY AND DEMAND
(December 31, 1984)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U as UF_6) Within 3 Years	Beyond 3 Years	Remarks
Available for Sale:			
ACTIVE			
2141	1,000	—	
TOTAL:	1,000		
INACTIVE			
2051	1,000	—	
2438*	500	250 per year	1986-87
2511	600	700	1986-90
TOTAL:	2,100		
Inquiries to Purchase:			
ACTIVE			
2644*	—	475	1987 on
TOTAL:	0		

*New or revised since last month.
[1] Measured from the date of this Report.
Projects removed since last month: 2560.

LOAN SUPPLY AND DEMAND
(December 31, 1984)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Within 1 Year	Beyond 1 Year	Remarks
Available for Loan:			
INACTIVE			
1938	2,000	—	UF_6
2128	700	—	
2139	2,000	—	
2469A	800	—	
2483	550	—	
TOTAL:	6,050		

*New or revised since last month.
[1] Measured from the date of this Report.

No inquiries to borrow this month.

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CURRENT MARKET DATA

SWU SUPPLY
(December 31, 1984)

	Delivery Period[1] (Thousands of SWUs)		
Nuexco Project Number	Spot or Near-term[2]	Intermediate or Long-term	Remarks
Available for Sale:			
ACTIVE			
2100	150	100 per year	
2359*	130	—	
2583	50	—	
2624	100	—	
2631	150	—	
2632	25	—	
2285	—	300	
2378	—	120	1988
2510	—	50	
2513	—	25	1986
2517	—	150	1986-89
TOTAL:	605		
INACTIVE			
2164	25	—	
2589	50	—	
2531	—	150	1987
2571	—	55	1987
TOTAL:	75		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes SWUs deliverable within one year under other than spot or near-term contracts.

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CURRENT MARKET DATA

SWU DEMAND
(December 31, 1984)

Nuexco Project Number	Delivery Period[1] (Thousands of SWUs) Spot or Near-term[2]	Delivery Period[1] (Thousands of SWUs) Intermediate or Long-term	Remarks
Inquiries to Purchase:			
ACTIVE			
2459*	30	—	
2480*	30	—	
2655	10	—	
2519	—	30 per year	1987 on
2578*	—	100	1986
2653	—	100	1986-90
2658*	—	5	1986
TOTAL:	70		
INACTIVE			
2443*	50	—	
2543	25	25	1986
2500	—	500	1987-90
2512	—	15 per year	1987 on
2585	—	100	1986
2595*	—	50	1986
TOTAL:	75		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes SWUs deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2550.

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OPTIMUM TAILS ASSAY—PART 3

Introduction

Part 1 of this series (Report 195) developed the concept of the tails assay for which the cost of enriched uranium product is a minimum, assuming that the unit costs of feed material and SWU are both known constants. Part 2 (Report 196) discussed the variability of SWU prices with tails assay, and extended the concept of the minimum product cost to some instances of varying SWU prices. This third and final article in the series expands the analysis to include the dependence of inventory carrying costs on the tails assay, and discusses the true optimum tails assay for nuclear fuel management.

The Optimum Tails Assay

The objective by which utilities are measured is their ability to provide dependable service to their customers at the lowest possible cost. Given this goal, the optimum tails assay is the one which yields the lowest total fuel cost to the customers.

The fuel cost which is charged to customers is established by the nuclear fuel accounting system. There are nearly as many accounting systems as there are utilities, but (in the United States at least) utilities are regulated monopolies with the same central philosophy; all money prudently spent on the fuel is charged to the customers. However, customers are not billed as each fuel expense is incurred; they pay as the fuel is consumed. The fuel accounting system must keep track of all investments on a batch of fuel, as well as the interest (carrying) costs on these investments until they are repaid by the customers.

There are two different philosophies used in treating inventory carrying costs. Privately owned utilities are allowed to include in their electric rates a return on the investment in fuel which is included in their rate base*. If the fuel inventory is not included in the rate base, the accumulated carrying costs are added to the book cost of the fuel in inventory. From the customer's viewpoint, it matters little whether uranium inventory carrying charges are paid each year as a return on investment or accumulated and included in the cost of enriched product. For the following analyses, it is assumed that fuel is not in the rate base until it is loaded into the reactor, and the accumulated carrying charges are included in the unit costs of the fuel components.

At the time a batch of fuel is inserted in the reactor, the total cost is divided by the energy the batch is expected to produce, giving a unit fuel cost to be charged to the customers. The total cost usually consists of five components: natural uranium feed, enrichment services, fabrication, disposal, and inventory carrying charges. The costs of fabrication and disposal components are independent of the enrichment tails assay, and will not be discussed further. The natural uranium and enrichment costs together constitute the cost of enriched uranium product. Carrying costs prior to irradiation are included in the component costs, and irradiation carrying charges are a multiplier of the cost of enriched product, and do not influence the tails assay selection. The optimum tails assay for the customer would appear to be the assay which minimizes the product cost. However, as shown below, this is usually not the case.

High Cost Uranium Inventory

Many utilities have some inventory of natural uranium feed, either the result of a deliberate decision to stockpile uranium or as a consequence of construction delays. Consider the following simplified example:

A utility has a 1,000-MWe reactor on an annual refueling cycle which requires 20 MTU of 3.5% enriched uranium per year. This utility has 1,500,000 lbs. U_3O_8 equivalent in inventory as UF_6. This inventory has a "book" value of $150/KgU ($55/lb. U_3O_8, $3/lb. U conversion), which is the original purchase price plus the cost of carrying the inventory to the current date. The utility has no existing contracts for natural uranium, and plans to purchase new material to meet requirements after its inventory has been exhausted. The price for new natural uranium is $55/KgU ($20/lb. U_3O_8, $1/lb. U conversion) plus escalation. There is a requirements enrichment contract for $135/SWU plus escalation, which is not a function of tails assay. The utility has a cost of capital and discount rate of 10 percent, and assumes an escalation rate of 5 percent. What is the optimum tails assay for this utility—the tails assay which will result in the lowest cost of fuel for its customers?

First Year Costs

The cost of the enriched product assigned to each fuel batch, and thus passed on to the customer, is determined by the following equation (see Report 195):

$$\begin{aligned}\text{Product Cost} = {} & \text{Feed Factor} \times \text{Unit Feed Cost} \\ & + \text{SWU Factor} \times \text{Unit SWU Cost}\end{aligned}$$

---

*The fuel rate base is defined as the net investment in the fuel necessary to serve the customers. This has been interpreted by some regulatory agencies to mean only fuel loaded in the reactors, while others consider extensive natural uranium inventories to be necessary.

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The Feed and SWU factors are a function of tails assay and product enrichment. Once the tails assay has been selected, the assigned cost of enriched uranium for the first batch can be calculated using the feed book cost of $150/KgU and the first year SWU cost of $135. The cost of the enriched uranium product (in $/KgU) for the first year is shown as a function of the enrichment tails assay in Figure 1.

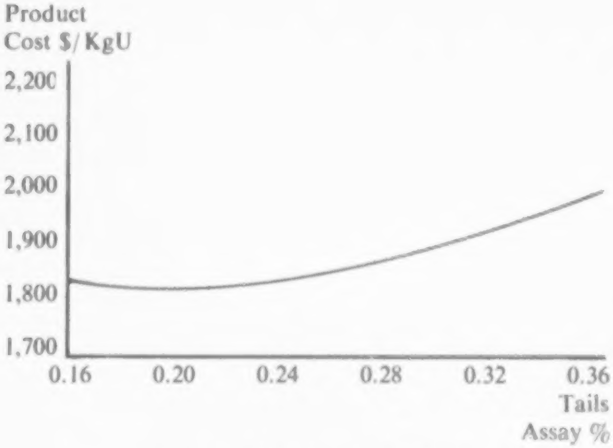

Figure 1. First Year Fuel Cost

The utility has a relatively high feed cost, so the cost of fuel assigned to its first reload batch is reduced by using a low tails assay (less feed and more SWU). The optimum tails assay for the first year's fuel cost can be derived directly from the relationships developed in Part 1 for the minimum cost of enriched product, given constant SWU and feed costs. The first year feed/SWU cost ratio is 1.1, and the tails assay for minimum product cost is about 0.22 w/o, which is the same as the tails assay for the lowest fuel cost in Figure 1.

Costs for Future Years

While a tails assay of 0.22 w/o is indeed the optimum for the first batch, it does not yield the lowest cost for fuel in future years. Figure 2 shows the average cost of a kilogram of enriched uranium for *six* batches of fuel.

The long term fuel cost (which includes the first year) has the opposite dependence on tails assay, and indicates that a tails assay of at least 0.36 percent would provide the lowest fuel costs to the customers. What has happened to create this apparent anomaly?

The answer lies in the fuel cost accounting system and the cost of carrying the natural uranium in inventory.

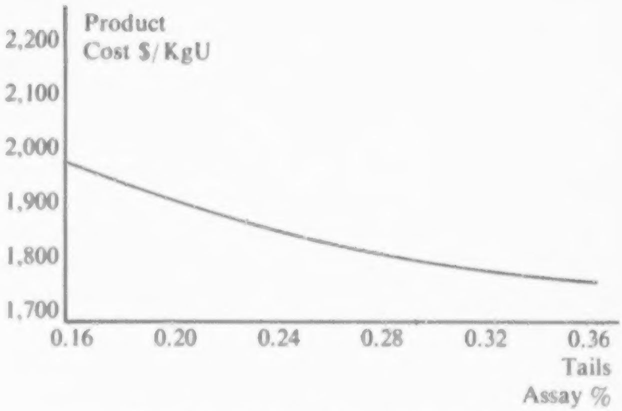

Figure 2. Six Year Average Fuel Cost.

Figure 3 shows the natural uranium inventory in terms of years of forward supply at the end of each year for several different tails assay selections. The original inventory will be consumed at a rate of 350,000 lbs. U_3O_8 per year at a tails assay of 0.22 w/o, while 467,000 lbs. will be used each year at a tails assay of 0.36 w/o.

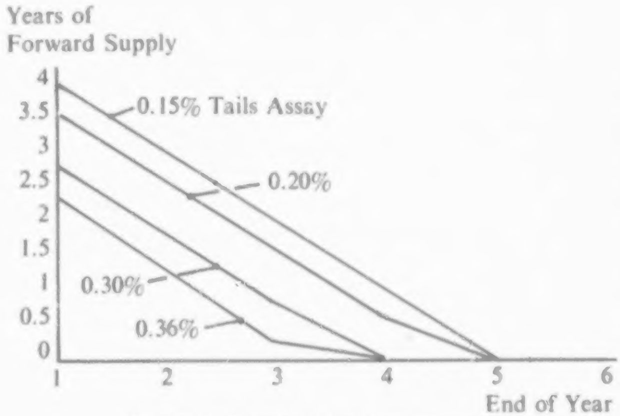

Figure 3. Natural Uranium Inventory.

There is a cost of carrying inventory material of 10 percent per year, which is paid by future customers, as the book cost of the feed material is increased by the accumulated carrying charges. In real terms, this cost is reduced by the appreciation of inventory value, i.e., if the cost of replacement material increases. In this example, the cost of replacement feed is lower than the inventory cost, so the appreciation is negative and real carrying costs are very high.

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Figure 4 provides further insight into the example, showing the average annual assigned cost per kilogram for years one through six. In this figure, future costs are discounted by the customer's time value of money (assumed to be 10 percent per year).

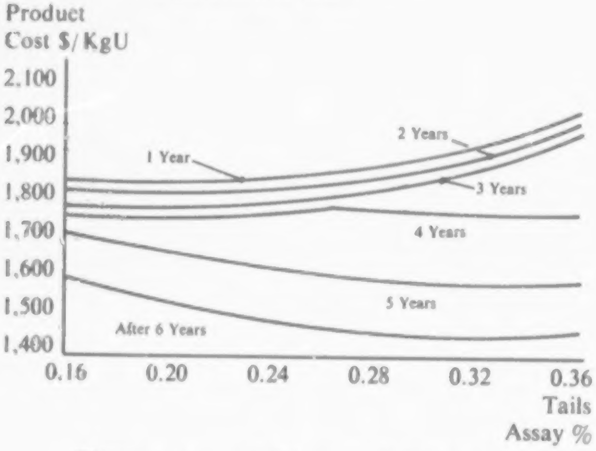

Figure 4. Average Discounted Fuel Cost.

The results show that optimum tails assay for the *average* cost of fuel assigned is about 0.22 w/o for the first 3 years, but jumps to about 0.32 w/o for planning horizons of over 5 years. The reason for this turnabout is that the original high-cost inventory is finally exhausted in year 4. At the higher tails assays, the cost savings for using market value feed in the later years overwhelm the higher assigned costs in the earlier years.

Determination of Optimum Tails Assay

If minimizing the cost of fuel assigned gives misleading results, what performance measurement should be used to calculate the optimum tails assay? In addition to the impact on the current batch, we must also consider the changes in costs for future batches. In the example, if lower tails assays were used to reduce current fuel costs, the feed material *not* used (costing $150/KgU plus accumulated carrying charges) had to be assigned to some future batch. If higher tails assays were used, the future batch could have used new material purchased at less than $75/KgU.

Discounting the future savings by the cost of money, the long-term optimum tails assay for utility customers can be approximated by the tails assay for minimum product cost (see Appendix), if the *discounted future price of uranium feed is used, rather than the book value.* In the example, assuming that additional feed is required in the fourth year, the market price of the next feed to be purchased, discounted to the current year, is $45.20/KgU. With $135 SWU, the optimum tails assay is approximately 0.35 w/o, which coincides well with the results of Figure 4. It should be noted, however, that both the example and the above approximation assume that the same tails assay is used each year.

Another commonly used method of determining the optimum tails assay is to minimize future discounted cash flow. The discounted cash flow at the end of one through six years is shown as a function of tails assay in Figure 5.

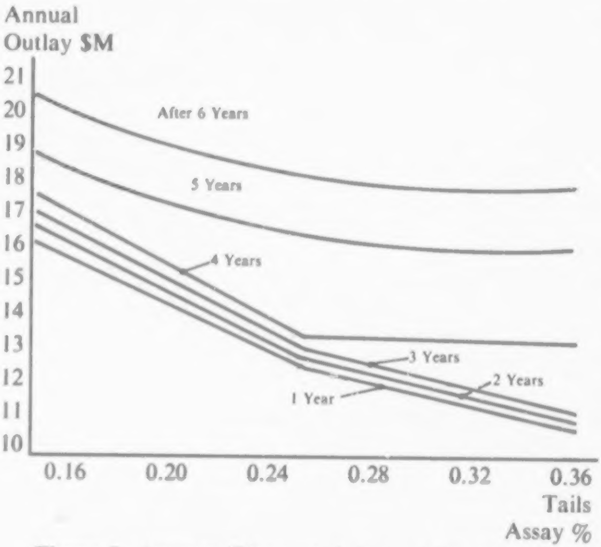

Figure 5. Average Discounted Annual Expenditure.

Comparing Figure 5 to Figure 4, the tails assay for minimum discounted cash flow is about the same as the tails assay for minimum fuel cost for planning periods beyond four years. However, tails assay for minimum cash flow in the first three years is unrealistically high, as there are no requirements for additional feed purchases in these years. The discounted cash flows for years 4 through 6 are more valid measurements, as they factor in replacement feed costs.

Other Fuel Management Objectives

While all utilities are concerned with reducing the costs of fuel assigned to their customers, many also consider the net investment in fuel (or credit requirements) to be an important measurement. If fuel in inventory is not includ-

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ed in the rate base, cash is only generated as the fuel is consumed to produced electricity. A batch of fuel is typically in the reactor for about four years, so the utility will receive income from a batch at the rate of about 25 percent of its assigned cost each year. Actually, income is somewhat higher for the first year, and lower for the last, due to uneven burnup rates. In any case, the utility must use its own capital or lines of credit to finance the fuel investment. This can be a critical problem for utilities that are in financial distress.

For the utility used in the example, a higher tails assay reduces net investment in two ways. First, in the earlier years, there are no cash expenditures for feed, and the higher tails assay reduces the SWU requirements, yielding lower cash outlays. The higher tails assay provides a second benefit, as the cost of fuel assigned to batches will be higher in the earlier years (see Figure 4), resulting in increased fuel costs for customers, and thus higher income. There should be no trouble in convincing regulatory agencies of the benefits of higher tails, as the net cost of fuel to the customer is reduced in the longer term.

Summary

In this series of articles, we have tended to focus on individual pieces of the tails assay puzzle, in order to illustrate the effect of each variable. There have also been a number of simplifying assumptions (such as the use of a constant tails assay, rather than one which varies from year to year). In today's market, all of the variables interact, and the true optimum tails assay is a complex function of the inventory, regulatory, financial and contractual situation for each utility.

In many of the cases, the assumptions of constant feed and SWU costs give the wrong trends of cost versus tails assay. It is clear that traditional methods of tails assay optimization are no longer adequate, and sophisticated analyses are necessary to enable fuel managers to realize their true objectives. Fortunately, the development of powerful personal computers and fuel management software has made it possible to perform those analyses relatively quickly and efficiently.

APPENDIX

Optimum Tails Assay with Uranium Inventory

The total cost impact of a batch of fuel is equal to its current assigned cost, plus its effect on the cost of future batches. The current assigned batch cost is:

$$\text{Product Cost} = B \times \text{Feed Factor} + \text{SWU Cost} \times \text{SWU Factor},$$

where B is the book value of natural uranium feed.

In some future year N, the utility will have to purchase additional feed material. In that future year, the utility will use some amount (I) of feed material from inventory, and some amount (M) from the future purchase. If the tails assay in the current year is increased to some new value so that one additional kilogram of inventory material is used, this will reduce the quantity I by 1 KgU and increase M by the same amount. The fuel cost in the future year will be reduced by the difference between the cost of the inventory material in year N (the current book cost B, plus N years of compounded interest (i)) and the cost of the future purchase (P):

$$\text{Future Cost Difference} = P - B \times (1 + i)^N$$

Discounting the future cost difference by the same interest rate yields:

$$\text{Discounted Future Cost Difference} = P/(1 + i)^N - B.$$

Returning to the cost of the current assigned batch, with the increased tails assay, the difference between the new and the old cost is:

$$\text{Product Cost}' - \text{Product Cost} = B + \text{SWU Cost} \times (\text{SWU Factor}' - \text{SWU Factor})$$

Combining the current product cost with the discounted future cost difference gives:

$$\text{Total Cost}' - \text{Total Cost} = P/(1 + i)^N + \text{SWU Cost} \times (\text{SWU Factor}' - \text{SWU Factor})$$

By inspection, the equation for the total cost differential is similar to the equation for the product cost differential, except that the discounted future price for feed is used instead of the current feed book value. Thus, the tails assay for the minimum total cost can be found by using the discounted future price in the equations for the minimum product cost.

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US NUCLEAR FUEL FABRICATORS

Introduction

Five companies in the USA fabricate nuclear fuel for light-water reactors (LWRs). General Electric Corporation, Westinghouse Electric Corporation, Exxon Nuclear Company, and Combustion Engineering, Inc. produce fuel assemblies by converting enriched UF_6 to UO_2 powder, forming fuel pellets, and loading the pellets into fuel rods (Table 1). The rods are arranged into bundles and shipped to reactors throughout the world. The fifth US company, Babcock and Wilcox, performs rod assembly using fuel pellets supplied by G.E. The fabricators provide engineering support services such as fuel management and in-core monitoring, and are continuing research and development of new fuel technology that will facilitate fuel burnup efficiency and enhance power distribution control. The fabricators are enacting new design and operational strategies in an attempt to reduce fuel cycle costs.

The Fabrication Process

Although techniques used by each fuel fabricator vary, the basic process is standard throughout the industry. All fabrication processes for fuel used in LWRs begin with the conversion of enriched UF_6 to uranium dioxide, UO_2. In the most commonly used process, the gaseous UF_6 reacts with ammonia and water to form ammonium diuranate. The resulting precipitate is calcined (roasted) to form UO_3, which is reduced with hydrogen to produce the UO_2 powder. The powder is sampled and analyzed for fluoride and moisture content, and then it is pressed into pellets. The pellets are sintered to increase the fuel density and remove moisture, a process which permits the loading of proportionately more fuel per tube. Moreover, sintering reduces the densification of fuel pellets while in the reactor, a condition which can cause fuel failures. The pellets are then ground to uniform size and are ready to be loaded into fuel rods.

Most fuel rod tubes are made of Zircaloy, a zirconium alloy which is highly corrosion resistant and absorbs few neutrons. Localized fuel failures often are caused by rapid changes in core power levels during normal operation. Such power changes can cause local stress loading and chemical reactions between pellets and cladding, called pellet-clad interaction (PCI). When differential thermal expansion occurs between the pellets and cladding as reactor power increases, the cladding can crack. All of the US fabricators have launched efforts to counter the effects of local stress loading and PCI.

The pellets are loaded into the fuel rods to precise specifications to allow for pellet expansion and efficient burnup. The rods are filled with an inert gas such as helium to provide thermal conductivity and avoid chemical reactions with released fission gases; a plenum spring is inserted, and end caps are welded on. The plenum spring exerts a downward pressure on the stacked pellets, keeping them in place during the handling of the bundle (Figure 6). A thorough inspection sequence follows in which

Table 1

US NUCLEAR FUEL FABRICATORS

Company	Plant location	Fuel type	Production capacity (MTU in UO_2/year)
Babcock & Wilcox	Lynchburg, Virginia	PWR	400
Combustion Engineering	Hematite, Missouri[1] Windsor, Connecticut[2]	PWR	275
Exxon	Richland, Washington	PWR, BWR	700
General Electric	Wilmington, North Carolina	BWR	2,000
Westinghouse	Columbia, South Carolina	PWR, BWR	1,000

[1] Provides conversion only.
[2] Provides fabrication only.

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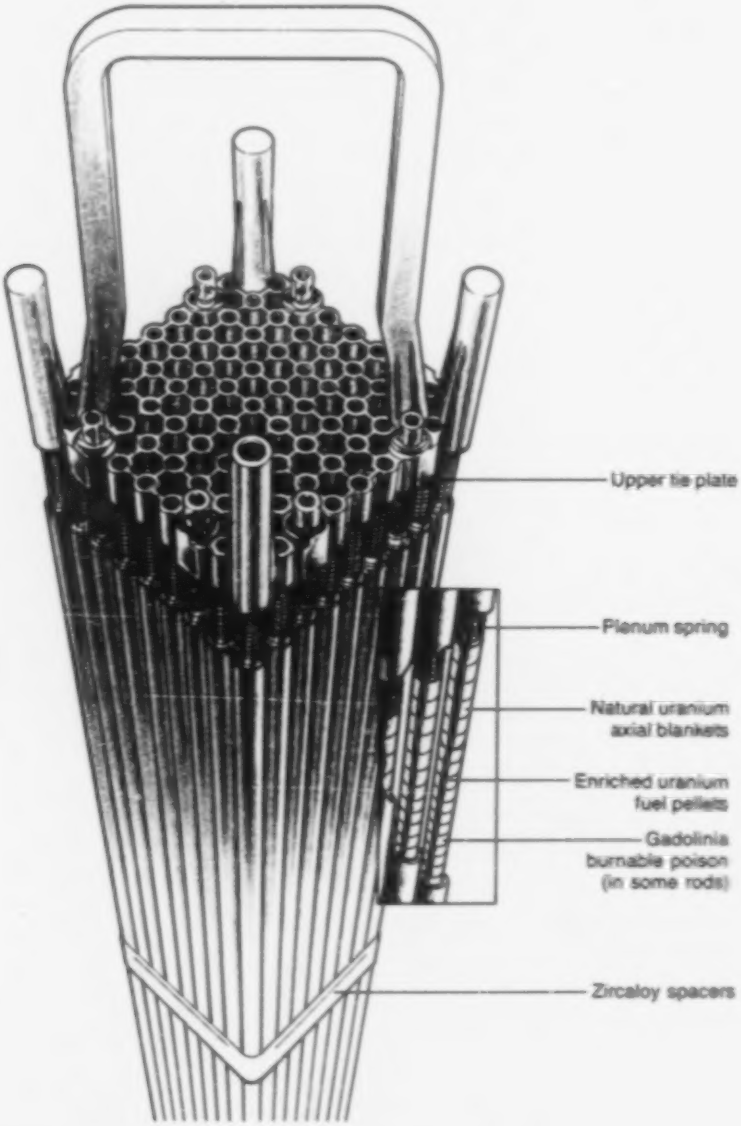
Upper tie plate
Plenum spring
Natural uranium axial blankets
Enriched uranium fuel pellets
Gadolinia burnable poison (in some rods)
Zircaloy spacers

Figure 6. Exxon 9×9 BWR fuel assembly.

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the rods are tested for weld integrity, pressurization, uniformity, and enrichment. Although PWR assemblies generally use pellets with uniform enrichment levels, several different enrichment levels are used in BWR fuel assemblies to reduce local power peaking. An initial core for a BWR has an average enrichment ranging from 1.6 weight-percent (w/o) U_{235} to 2.2 w/o U_{235} depending on initial cycle requirements. Each assembly contains approximately four different enrichments; low-enriched rods are used in the corner rods and the rods nearer the water gaps, while higher enriched rods are placed toward the center of the fuel bundle (Figure 7). Reload fuel usually contains a higher average enrichment level, in the range of 2.4 w/o to 3.0 w/o. Selected rods contain pellets that have been blended with a burnable poison (gadolinium nitrate), a neutron absorber that helps moderate the reaction, yet also is consumed along with the U_{235} so that it does not inhibit the reactivity at the end of each operating cycle.

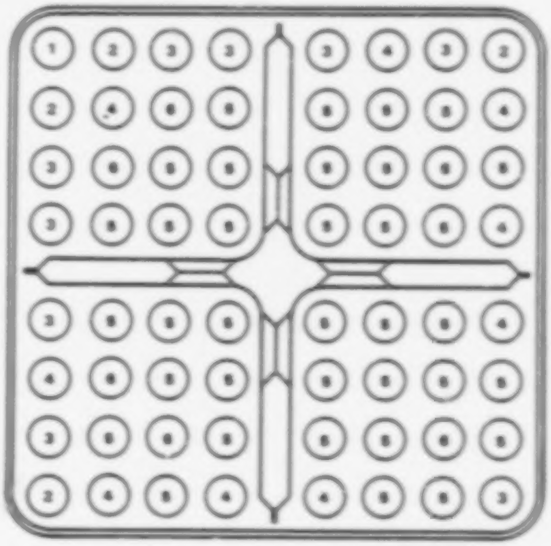
The Commercial Fabricators

Westinghouse Nuclear Fuel Division fabricates fuel assemblies at its plant in Columbia, South Carolina. The plant began operation in 1969, with a capacity of 200 metric tons uranium (MTU) produced each year, and has manufactured and shipped over 15,000 nuclear fuel assemblies to its customers worldwide. Current annual fabrication capacity of the Columbia plant is over 1,000 MTU in UO_2. The Nuclear Fuel Division also operates the Westinghouse Specialty Metals Plant in Blairsville, Pennsylvania. The Specialty Metals Plant manufactures Zircaloy fuel rod cladding for use at the Columbia plant as well as for customers worldwide.

In recent years, Westinghouse has developed programs designed to improve the quality of fuel products, including the improvement of fuel rod and plug welding techniques, the reduction of fuel hydrogen levels, and better rod handling techniques. The Westinghouse Optimized Fuel Assembly (OFA) design, introduced into commercial operation in 1983, incorporates several features intended to improve fuel economy, such as Zircaloy grids for rod spacing in the bundle, and a smaller fuel rod diameter to accommodate more fuel rods per bundle. Eight PWRs are operating with this design.

The most recent development is the VANTAGE 5 design. Consisting of several features including axial blankets (areas of natural uranium pellets at the top and bottom of each fuel rod), removable top and bottom nozzles, and integral fuel burnable absorbers, VANTAGE 5 features can be utilized individually or as a whole in PWR assemblies. The system is designed to improve fuel performance; the axial blankets are said to improve uranium utilization by 2.5 percent. Mechanical testing of the design has been completed, and all of the features have been delivered and loaded at South Carolina Electric & Gas Company's Summer Unit 1.

A new production facility, known as the Manufacturing Automated Project (MAP) is under way at the Columbia plant. MAP is intended to integrate automated systems for the manufacture of nuclear fuel rods. The process covers conversion of UF_6 to UO_2, pellet manufacture, and completion of the fuel rods. Westinghouse expects that the use of robotics and process automation techniques will result in greater efficiency and a significant reduction in manufacturing cycle time.



Rod Type	No. of Rods	Enrichment U_{235}
1	1	1.70
2	4	2.10
3	9	2.50
4	9	2.80
5	34	3.10
6	7	2.95

Lattice Enrichment: 2.873
Bundle Enrichment: 2.70

Figure 7. Uranium enrichment distribution for BWR fuel assembly.

Westinghouse also has been competing for BWR reload fuel orders and, under a licensing agreement with Asea-Atom of Sweden, has developed QUAD+ reload fuel in the hopes of supplanting some of General Electric's dominant share of the BWR fuel market. The QUAD+ design provides a water channel in the middle of the assembly which divides the fuel rods into four quadrants. Westinghouse has sold four QUAD+ demonstration assemblies to Tennessee Valley Authority's Brown's Ferry Unit 2 for delivery in early 1985.

General Electric began fabricating fuel at its Wilmington, North Carolina plant in 1968. The plant manufactures BWR fuel bundles in an 8×8 rod array, and has manufactured approximately 35,000 fuel bundles for BWR plants around the world. G.E. also has implemented manufacturing or technology exchange agreements in nine countries, including Kraftwerk Union in the Federal Republic of Germany and Asea-Atom in Sweden.

G.E. is placing increasing reliance on automation. Computer-controlled and monitored manufacture of Zircaloy tubing for fuel rods and automated inspection of cladding for dimensional characteristics are designed to improve product integrity. For the production of nuclear fuel, laser inspection systems and a mechanical handling system apply automation to the pelletizing process. The machines process the inspection data and decide to accept or reject components. Fabrication personnel study the rejected pellets to monitor the grinding and sintering processes.

Each G.E. BWR fuel bundle consists of 62 fuel rods and two water rods. The end plug of each fuel rod is stamped with a serial number so that the contained uranium can be traced from a cylinder of UF_6 to the reactor. Another tracking system, the Manufacturing and Information Control System (MICS), uses two large computers to monitor the flow of over a quarter million containers of uranium annually. Since the varying enrichment levels and location of the uranium that passes through the automated equipment must be monitored at all times, MICS was designed to keep track of materials through the entire manufacturing process to prevent the mixing of enrichments.

The final quality control step in the manufacture of gadolinia fuel rods at Wilmington is performed by the Magnetic and Passive Scanner (MAPS). MAPS, a superconducting magnetometer, measures the uranium and gadolinium content of every pellet in every finished fuel rod. Superconducting coils immersed in liquid helium at a temperature of four degrees Kelvin (4 degrees above absolute zero) scan the rods and the system stores the data, including pellet density, cladding wall thickness, and gaps between pellets.

G.E.'s recent workforce cut at Wilmington did not affect the fuel fabrication division, although 200 other jobs were lost, mostly in the reactor parts division. G.E. is testing its newest fuel design, GE9B, and plans to begin marketing it in a few years. The current design, GE8B, utilizes the barrier fuel concept. A thin protective layer of soft zirconium metal is bonded to the inner surface of the cladding. G.E. expects it to provide resistance against pellet-clad interaction (PCI), the mechanical and chemical reaction between fuel pellets and cladding, a chief cause of localized fuel failures.

Exxon Nuclear Company, a wholly-owned affiliate of the Exxon Corporation, fabricates fuel for BWRs as well as PWRs. It also provides engineering services such as in-core fuel management, in-core monitoring, and irradiated fuel performance evaluation. The fabrication facility, located in Richland, Washington, has been expanded several times since 1969 and currently has a capacity of 700 MTU per year. Exxon has fabricated and delivered over 5,000 fuel assemblies to 39 nuclear plants throughout the world. Approximately half are BWRs and half are PWRs.

Like the Westinghouse VANTAGE 5, Exxon fuel assemblies utilize dismountable upper tie plates for both BWRs and PWRs. As a result, it was possible to repair and reinsert 12 damaged rods in Belgium's Tihange Unit 1 PWR assemblies. Gadolinia burnable poison, originally developed for BWRs, has been successfully extended to PWRs, resulting in improved fuel efficiency. In 1982, Exxon completed a study which indicated some advantages of a 9×9 fuel rod array for BWR assemblies; Exxon concluded that the 9×9 design has substantial fuel cycle benefits as well as increased resistance to PCI. The company also is involved in several joint venture research programs aimed at further improvement in fuel performance and fuel cycle cost.

Exxon offers a range of fuel-related engineering services designed to augment its delivery of nuclear fuel. These include fuel management and licensing, in-core monitoring, poolside irradiation fuel examinations, and irradiated fuel reconstitution. In addition, Exxon introduced a core monitoring software system, in use on several BWRs, as a method of correlating power distribution data and assisting with operational problems. The company is developing a similar model for PWRs. Exxon will demonstrate its advanced PWR fuel, utilizing annular pellets and zirconium cladding, in the spring of 1985 at

Rochester Gas and Electric's Ginna unit.

Combustion Engineering (C-E) has produced PWR fuel assemblies for eleven reactors in the USA. Two separate facilities are utilized. UF_6 is converted to UO_2 powder at the Hematite, Missouri plant, and the pellet fabrication and fuel rod assembly takes place in Windsor, Connecticut. The latter plant has a capacity of 275 MTU per year. Assemblies are manufactured in 14×14, 15×15, and 16×16 arrays, and the manufacturing process uses digitally-controlled equipment extensively.

Combustion Engineering, as a vendor of nuclear steam supply systems, is capable of directly providing all engineering support services. Reload engineering is closely tied to C-E's other activities as a reactor supplier, so that the technological exchange of information is consistent throughout C-E's programs. In addition, a technology exchange with Kraftwerk Union GmbH (KWU) of the Federal Republic of Germany involves a cooperation in research and testing.

Commercial utilization of many fuel performance innovations has been in effect for several years. C-E began using all Zircaloy grids in 1972, as well as low residual burnable poison absorbers with Zircaloy cladding. In 1974, C-E increased the plenum volume, or space inside the fuel rods, to provide greater high burnup capability. C-E has experience in handling reconstitutable fuel assemblies, having shipped reconstitutable fuel since 1974.

C-E is scheduled to deliver fuel to Yankee Atomic Electric Company's Rowe unit, a Westinghouse PWR, in the summer of 1985. It will represent the first C-E fuel assembly loaded into a reactor built by another vendor.

Babcock & Wilcox's Commercial Nuclear Fuel Plant (CNFP) has been involved in the manufacture of fuel assemblies for commercial nuclear power stations since 1963. The CNFP's scope of activities includes the fabrication of fuel assemblies, and the manufacture of spacer grids, burnable poison components, control components, in-core detectors, and associated parts. B&W provides complete mechanical design, quality assurance, fuel management, and reload licensing.

B&W provides PWR fabrication assembly services at its facility in Lynchburg, Virginia, but is no longer involved directly in the conversion or pelletizing processes for LWRs. B&W uses pellets manufactured by G.E. for its assemblies. In September 1982, B&W announced its decision to subcontract UO_2 powder and fuel production to G.E.'s Wilmington plant. At that time, B&W had been planning to shut down its own UO_2 powder production facility in Apollo, Pennsylvania because of reduced demand. The Apollo plant was shut down in the summer of 1983, and the first G.E. pellets were supplied in November 1983.

B&W employs several unique design concepts when fabricating LWR fuel assemblies. Two plenum springs, one on each end, are inserted in each fuel rod tube to prevent jamming or dislodging of pellets in transit. Floating Zircaloy spacer grids allow the independent expansion of each fuel rod; the rods are not welded to the spacer grid. B&W also introduced "keyed" spacer grids whereby a series of keys disengage springs in the grid, allowing the rapid removal of fuel rods during the fabrication and inspection processes.

When Northeast Utilities' Connecticut Yankee reactor recently broke the world record for consecutive days of continuous operation by a light-water reactor, the 575-MWe Westinghouse PWR generated more than 69 billion kilowatt-hours of electricity, about 60 percent of which was generated with B&W-manufactured fuel. Another reactor using B&W fuel assemblies, Duke Power Company's Oconee Unit 3, had a 1983 capacity factor of 94 percent, the highest for a reactor in the USA.

B&W fuel technology also has been implemented to some degree overseas. Nuclear Fuel Industries, Ltd. (NFI) of Japan designs and fabricates some PWR fuel assemblies under a licensing agreement with B&W. Signed in 1976, the long-term agreement transferred B&W's PWR fuel technology to NFI. NFI now supplies about 40 percent of the Japanese PWR reload fuel market.

CORRECTION

In the *FOCUS* article on Sweden in Report 196 (December 1984), a line was dropped out inadvertently in the typesetting process. The reference to the USEC conversion status of Sydkraft and SSPB on page 24 should have read:

Both Sydkraft and SSPB have contracts with DOE for enrichment services; while Sydkraft converted its Requirements *contract to the USEC, SSPB has not converted its two 3.5-year Requirements* contracts and five AFCs (Adjustable, Fixed-Commitment contracts) to the USEC.

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UNITED STATES

Introduction

In early December, three US uranium producers filed suit against the US Department of Energy (DOE) and various DOE officials in the US District Court in Colorado. Western Nuclear, Inc., Energy Fuels Nuclear, Inc., and Uranium Resources, Inc., with the support of other producers, filed a civil action asking the court to declare the Utility Services' Enrichment Contract (USEC) null and void. The wide-ranging complaint also seeks:

1. To have DOE's definition of viability of the US uranium industry invalidated and to require DOE to restrict the enrichment of non-US origin uranium for domestic end use until such viability is assured;
2. To prohibit DOE from utilizing a fixed tails assay and restricting uranium demand through the VTAO surcharge in the USEC;
3. To prohibit DOE from selling uranium, either directly or indirectly (via such mechanisms as the split tails and pre-produced inventory policies) in competition with the domestic uranium industry.

Commentary

The lawsuit is the culmination of efforts, begun in 1980, by the US uranium industry to strengthen the domestic uranium market. Prior to the lawsuit, the industry focused its attention on legislative attempts to limit US utility use of non-US origin uranium. The first attempt occurred in the fall of 1980 when Senator Domenici (R, New Mexico) attempted to attach an amendment to DOE's 1981 appropriations bill. The amendment was deleted from the bill when requisite support failed to materialize (see Report 146, October 1980).

Senator Domenici tried again in March 1982 when he proposed the requirement that 80 percent of the uranium used by US reactors must be of US origin. This attempt also failed, and the pro-embargo forces achieved neither their original 20-percent limit nor a compromise 37.5-percent limit on imports of non-US origin uranium. However, in January 1983 they did succeed in passing legislation that established a framework of studies and required reports that could be utilized to implement import restrictions in the future (Report 174, February 1983).

The results of this legislation have disappointed US producers. The President's March 31, 1984 Report to the Congress on the US uranium industry was not seen as supportive, and the Reagan administration has shown a marked reluctance to support embargo initiatives of the type sought by the US industry.

In this context, the USEC became the final affront to industry expectations. The USEC is a requirements-type contract which reduces and defers uranium demand. Further, a surcharge was added making tails assays above 0.20 w/o U_{235} less attractive and, as the result of individual negotiation, a number of utilities gained the right to utilize existing inventories of enriched product, further reducing and delaying the need for new supplies of material.

Despite a series of meetings with DOE and the threat of a lawsuit since early 1984, the US producer group was unable to obtain any tangible relief from DOE. DOE spent much of 1984 developing enrichment policies that would allow retention of its market share which was under challenge from foreign suppliers and the secondary market.

If the courts voided the laboriously constructed USEC, DOE's credibility would be impaired severely, particularly among foreign customers who have little understanding of the US judicial system. Urenco and Eurodif would achieve substantial gains at DOE's expense.

In a report released on December 27, 1984, the General Accounting Office (GAO), the investigative body of Congress, appeared to lend considerable support to the producers' contentions about the USEC. The GAO report was highly critical of DOE, adding that DOE's "actions with regard to the new Utility Services Contract were not in compliance with applicable statutory principles." GAO further noted that the $135 per SWU price "would violate the Atomic Energy Act's provision requiring cost recovery." The greatest potential impact of the GAO report could arise from a Congressional reaction that forces DOE compliance with the law as interpreted in that report.

Many obstacles confront a negotiated resolution to the situation. Dropping the VTAO surcharge or the fixed tails policy would result in a revenue loss that would jeopardize DOE's assertion of full cost recovery based on the $135.00 price. Embargoes are equally unlikely given the current administration's reluctance to support such measures. One possible alternative involves a proposal which would require that US origin uranium be used as feed for any enriched product produced with marginally priced SWU. It is doubtful, however, that the producers would consider this an adequate resolution.

It seems unlikely that the courts will dismiss the complaint out of hand. Extended legal maneuvering and new negotiations between the two sides are likely outcomes of the lawsuit.

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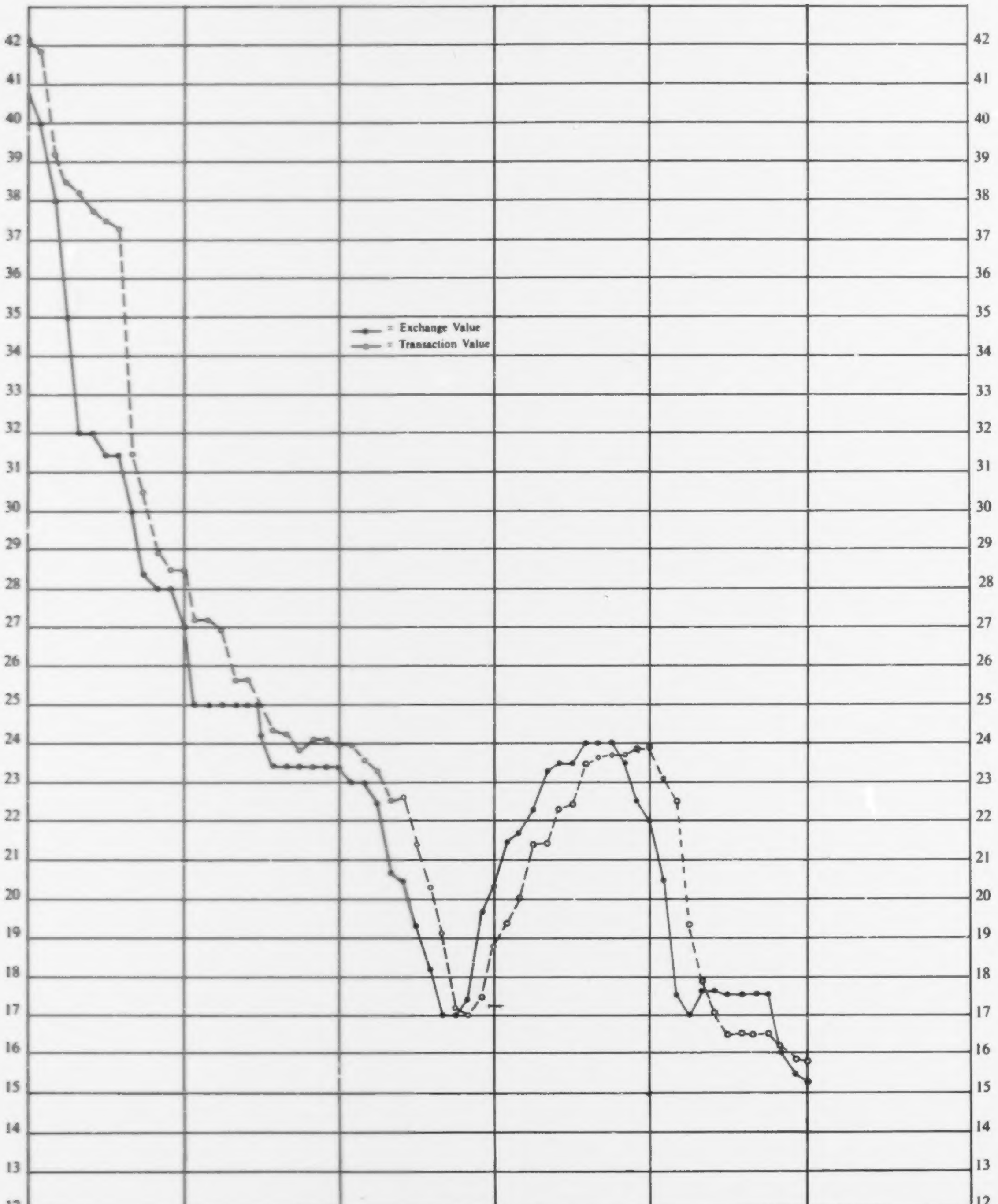
HISTORICAL MARKET DATA

EXCHANGE AND TRANSACTION VALUES SINCE JANUARY 1980

Determined as of the last day of the month indicated



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HISTORICAL MARKET DATA

HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	—	—	—	—	—	—	—	6.35	6.35	6.40	6.45	6.50
1969	—	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	32.50	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00
1981	25.00	25.00	25.00	25.00	25.00	24.25	23.50	23.50	23.50	23.50	23.50	23.50
1982	23.00	23.00	22.50	20.75	20.50	19.25	18.25	17.00	17.00	17.50	19.75	20.25
1983	21.50	21.75	22.25	23.25	23.50	23.50	24.00	24.00	24.00	23.50	22.50	22.00
1984	20.50	17.50	17.00	17.75	17.75	17.50	17.50	17.50	17.50	16.00	15.50	**15.25**

HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	—	—	—	—	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38.40	37.90	37.60	37.30	31.60	30.60	29.00	28.70	27.70
1981	27.20	27.20	27.00	25.70	25.70	24.50	24.40	24.30	23.90	24.10	24.10	24.00
1982	24.00	23.70	23.40	22.60	22.70	21.50	20.30	19.10	17.30	17.00	17.55	18.80
1983	19.35	20.00	21.35	21.40	22.35	22.45	23.50	23.60	23.65	23.65	23.85	23.85
1984	23.05	22.50	19.25	17.90	17.00	16.50	16.60	16.40	16.55	16.05	15.90	**15.90**

HISTORICAL CONVERSION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U as UF_6)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	1.20	1.20	1.20	1.40	1.15	1.15	1.15	1.10	1.10	1.10	1.20	1.20
1982	1.20	1.20	1.20	1.20	1.00	1.00	1.00	0.90	1.10	1.60	1.45	1.45
1983	1.20	1.40	1.40	1.20	1.20	1.20	1.10	1.10	1.00	0.60	0.60	0.60
1984	0.60	0.30	0.80	0.80	0.80	0.00	0.00	0.80	1.00	1.00	0.80	**0.80**

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AUSTRALIA

	Price Index of Materials Used in Manufacturing Industry—All Groups[1] (1969=100)	Award Rates of Pay Indexes Australia—Adult Males In Mining Wage and Salary Earners, Weekly Rates[2] (1976=100)
1983 Avg.	401.2	181.8
Aug 1983	403.0	180.7
Sep 1983	402.9	180.6
Oct 1983	397.5	188.3
Nov 1983	395.5	188.3
Dec 1983	399.2	188.1
Jan 1984	399.2	188.6
Feb 1984	402.5	188.5
Mar 1984	403.9	188.3
Apr 1984	404.2	196.2
May 1984	403.8	196.9
Jun 1984	404.9	196.9
Jul 1984	408.5	196.9
Aug 1984	413.3	196.9
Sep 1984	412.1	196.9
Oct 1984	408.7	—

P = Preliminary R = Revised since last month

CANADA

		Wage-earner Data: Average Hourly Earnings (C$)[2]					
	Industry Selling Price Index: Manufacturing[1] (1971=100)	Uranium Mines (SIC 057)	Metal Mines* (SIC 051-059)	Mines, Quarries and Oil Wells[3] (SIC 051-099)	Primary Metal Industries Non-ferrous[4] (SIC 296)	Primary Metal Industries Non-ferrous[4] (SIC 298)	Chemicals and Chemical Products[5] (SIC 372-379)
1983 Avg.	298.8	—	—**	14.30	—	—	11.17
Sep 1983	301.1	17.66	14.90	14.41	11.99	10.32	11.29
Oct 1983	301.6	17.73	15.27	14.65	11.76	10.03	11.30
Nov 1983	301.8	17.82	15.29	14.67	11.78	10.62	11.38
Dec 1983	302.9	17.84	15.11	14.66	11.86	10.60	11.51
Jan 1984	305.4	17.74	15.27	14.74	11.91	10.84	11.69
Feb 1984	306.6	17.78	15.59	14.90	12.04	10.82	11.51
Mar 1984	308.7	18.05	15.52	14.82	12.14	10.84	11.58
Apr 1984	310.5	18.06	15.83	15.10	11.96	10.34	11.63
May 1984	310.6	18.48	15.64	15.06	12.11	10.16	11.65
Jun 1984	311.0	18.08	15.48	14.80	12.38	10.40	11.66
Jul 1984	312.8	17.81	15.72	14.92	12.53	10.18	11.82
Aug 1984	312.7R	17.24	15.36	14.92	12.44	10.34	11.78
Sep 1984	312.0	17.68R	15.96R	15.34R	12.51R	10.52R	11.90R
Oct 1984	312.3R	17.64P	16.05P	15.19P	12.65P	10.64P	12.00P
Nov 1984	313.5	—	—	—	—	—	—

P = Preliminary R = Revised since last month

For annual averages prior to 1983, and for notes pertaining to these statistics, see pages 23-26 of Report 190 of June 1984.

*The 1980 average for Metal Mines was incorrectly reported as 10.59. The correct average is 10.58 (see Report 190).

**Two different methods were used in the 1983 "Metal Mines" category in reporting survey data, and Statistics Canada did not publish a 1983 average. The March 1983 figure for the old method was 14.73 and for the new method was 14.84. The published average for 1983 in Report 190 was a Nuexco calculation based on the available monthly statistics for 1983 with the exception of the March figure, where only the 14.84 value was taken into account.

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GOVERNMENT STATISTICS

REPUBLIC OF SOUTH AFRICA

	Average Declared Working Costs per per Metric Ton of Gold Ore Milled (Rand)[1]	Tonnage-Weighted Index of Average Working Costs per Metric Ton of Gold Ore Milled (March 1982=100)[2]	Consumer Price Index[3] (1975=100)[4]	Producer Price Index All Groups[5] (1975=100)	Total Employment in Mining and Quarrying (Code 35)[6]	Total Salaries and Wages in Mining and Quarrying (1,000 Rand) (Code 40)[6]
1983 Avg.	51.87	115.0	262.2	274.8	696,579	3,644,772
Oct 1983	—	—	270.0	281.0	693,225	311,418
Nov 1983	—	—	271.4	281.6	688,459	317,485
Dec 1983	53.70	119.6	273.2	283.7	690,750	333,595
Jan 1984	—	—	274.7	283.3	689,807	326,619
Feb 1984	—	—	278.4	286.5	702,553	335,906
Mar 1984	55.30	123.1	281.9	288.0	715,628	342,332
Apr 1984	—	—	286.1	290.2	712,963	327,550
May 1984	—	—	288.3	292.6	710,040	327,937
Jun 1984	56.95	126.2	291.2	295.3	717,009	347,121
Jul 1984	—	—	295.1	296.0	717,121	369,964
Aug 1984	—	—	297.0	300.8	721,905	361,357
Sep 1984	60.64	133.2	299.9	304.1	721,723	359,218
Oct 1984	—	—	303.7	308.7	—	—
Nov 1984	—	—	307.4	—	—	—

UNITED STATES

	Producer Price Index[1]		Consumer Price Index[2] (1967=100)	GNP Implicit Price Deflator[3] (1972=100)	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[4]			
	Industrial Commodities (1967=100)	All Commodities (1967=100)			Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)	Electric and Electronic Equipment (SIC 36)
1983 Avg.	315.8	303.1	298.4	215.63	12.57	13.43	10.59	8.65
Aug 1983	317.3	304.7	300.3	—	12.54	13.46	10.62	8.62
Sep 1983	317.1	305.3	301.8	216.44	12.62	13.46	10.70	8.73
Oct 1983	318.5	306.0	302.6	—	12.67	13.55	10.79	8.71
Nov 1983	318.3	305.5	303.1	—	12.64	13.56	10.86	8.77
Dec 1983	318.4	306.1	303.5	218.53	12.75	13.33	10.90	8.84
Jan 1984	319.1	308.0	305.2	—	12.67	13.38	10.91	8.88
Feb 1984	320.6	308.9	306.6	—	12.81	13.34	10.90	8.86
Mar 1984	321.9	311.0	307.3	220.58	12.85	13.33	10.95	8.88
Apr 1984	322.5	311.4	308.8	—	12.91	13.30	10.97	8.89
May 1984	323.3	311.7	309.7	—	12.99	13.37	11.02	8.89
Jun 1984	323.9	311.4	310.7	222.40	12.96	13.40	11.03	8.91
Jul 1984	324.0	312.0	311.7	—	13.02	13.36	11.12	8.95
Aug 1984	323.5	310.9	313.0	—	13.10	13.51	11.13	9.00
Sep 1984	322.3	309.5	314.5	224.36	13.20R	13.39R	11.23R	9.08
Oct 1984	323.2	309.4	315.3	—	13.28P	13.53P	11.31R	9.07P
Nov 1984	323.8	310.4	315.3	—	—	—	11.38P	9.18P

P = Preliminary R = Revised since last month

For annual averages prior to 1983, and for notes pertaining to these statistics, see pages 23-26 of Report 190 of June 1984.

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NUEXCO

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NUEXCO

EXECUTIVE SUMMARY
REPORT 197
(All data as of December 31, 1984)

Exchange Value **$15.25, down $0.25**	The **Exchange Value** is **$15.25** per pound U_3O_8, down $0.25 since last month. Seven recent uranium sales are reported, involving a total of 2.6 million pounds U_3O_8 equivalent. Six involved deliveries prior to 1986, and five met the conditions for inclusion in the Transaction Value.
Supply-Demand Ratio **fell to 2.9:1**	Active spot and near-term **uranium supply** amounts to **3.6 million** pounds U_3O_8 equivalent, down 1.6 million pounds since last month. Active spot and near-term **uranium demand** totals **1.3 million** pounds, down 60 thousand pounds. The spot and near-term **supply-demand ratio** declined to **2.9:1.**
Transaction Value **unchanged at $15.90**	The **Transaction Value** is **$15.90** per pound U_3O_8, unchanged since last month. The calculation includes 16 transactions involving a total of 3.7 million pounds U_3O_8 and equivalent UF_6, and covers a period of 7 months.
Loan Use Charge Rate **unchanged at 6%**	The **Loan Use Charge Rate** remains **6 percent** per annum in a dormant market.
Conversion Value **fell to $0.80**	The **Conversion Value** is **$0.80** per pound U as UF_6, unchanged since last month. One secondary market conversion transaction is reported, involving approximately 275,000 pounds U as UF_6. Active secondary market supply of conversion services for delivery within three years totals 1.0 million pounds U as UF_6. No active demand is reported.
SWU Values: **$112 for DOE-origin (FY85)** **$15 discount for FY86** **$80 for non-DOE origin** **(delivery within 15 months)** **$90 for calendar year 1986**	The **SWU Values** for DOE origin at .3 tails and certifiable as excess, are **$112** per SWU for FY85 delivery, and **$15** per SWU discount from DOE base price for FY86 delivery. SWU Values for other SWUs (non-DOE or non-certifiable) are **$80** per SWU for delivery within 15 months, and **$90** per SWU for mid-to-late calendar year 1986. Two secondary market SWU transactions are reported, involving 90 thousand SWUs.
Analysis & Commentary	The last in a series of three articles on the concepts and applications of the optimum tails assay examines how the dependence of inventory carrying costs on the tails assay affects nuclear fuel management.
Basic Considerations	Five companies in the USA fabricate nuclear fuel for Light Water Reactors, as well as providing engineering support systems ranging from in-core management to fuel reconstitution.
United States	Three US uranium producers have filed suit against DOE, alleging that the USEC violates the Atomic Energy Act requirement that the USA maintain a viable uranium industry.
1984 Index	This Report includes an index to Reports published in 1984 (185–196).

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NUEXCO REPORT 197 FIGURES OF THE MONTH (December 31, 1984)	This Month (Report 197)	Last Month (Report 196)	12 Months Ago (Report 185)
Exchange Value[1]	15.25	15.50	22.00
Transaction Value[1]	15.90	15.90	23.85
Loan Use Charge Rate[2]	6%	6%	6%
Conversion Value[3]	0.80	0.80	0.60
Near-Term Uranium Supply[4]	3.6	5.2	5.9
Near-Term Uranium Demand[5]	1.3	1.3	2.5
Near-Term Supply-Demand Ratio	2.9	4.0	2.5
Recent Uranium Sales:			
Number of Transactions[6]	7	3	2
Quantity of Material[7]	2.6	9.8	1.0
Nuexco SWU Values:[8]			
DOE origin, certifiable as excess, 0.3 tails assay			
FY85 delivery	112	115	—
FY86 delivery	15[9]	15[9]	—
Other SWUs (non-DOE or non-certifiable)			
delivery within 15 months	80	85	—
delivery for calendar year 1986	90	95	—
USDOE SWU Prices:			
USEC	135.00	135.00	—
AFC	153.00[10]	153.00[10]	138.65
Requirements	157.00[10]	157.00[10]	149.85
Market Value of Enriched UF_6[11] [12]:			
2.5 w/o U_{235}	507	518	604
3.0 w/o U_{235}	657	671	774
3.5 w/o U_{235}	810	828	948
4.0 w/o U_{235}	965	987	1,124

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[1] US $ per pound U_3O_8 equivalent.

[2] Per annum.

[3] US $ per pound U as UF_6.

[4] Active inquiries to sell, for delivery within 12 months after contract signing (millions of pounds U_3O_8).

[5] Active inquiries to purchase, for delivery within 12 months after contract signing (millions of pounds U_3O_8).

[6] Uranium sales only; does not include loans, conversion, or SWU transactions.

[7] Millions of pounds U_3O_8, equivalent.

[8] US $ per SWU.

[9] Discount from USEC base price on delivery.

[10] Effective 10/1/84.

[11] Calculated using the Nuexco Exchange Value, Conversion Value, and 0.30 percent tails assay. From 10/31/83 through 2/29/84, calculations used the Nuexco SWU Value for DOE origin and FY84 delivery. As of 3/31/84, calculations use the Nuexco SWU Value for DOE origin and FY85 delivery.

[12] US $ per KgU as UF_6, rounded to the nearest $.

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FEBRUARY 1985 NUMBER 198

MONTHLY REPORT

ON THE NUCLEAR FUEL MARKET

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MONTHLY REPORT ON THE NUCLEAR FUEL MARKET

February 1985 No. 198

R. WESLEY MILLER, *EDITOR* CLARK M. BEYER, *ASSOCIATE EDITOR*

PRICING

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To Our Readers

Nuexco announces the election of George White, Jr. as Chairman of the Board of Directors replacing Bob Wolcott, who resigned.

From its founding in 1968, Nuexco has benefited from sound leadership. Founders George White, Sr. and A. Payne Kibbe were innovators and builders, taking an idea and turning it into reality. During the past eight years, Bob Wolcott's vision developed Nuexco into an international, full-service nuclear fuel organization. Bob's contribution was enormous and enduring.

The new management looks forward to continuing this record of excellence.

* * *

Nuexco will host a hospitality suite during the Atomic Industrial Forum's Fuel Cycle Conference in New Orleans, Louisiana, March 12–15, at the Hyatt Regency. We look forward to seeing you there.

* * *

Nuexco's US offices will be closed on Monday, February 18 in honor of George Washington and Abraham Lincoln's birthdays. Our European office will be open for business as usual.

* * *

Included in this Report is a map to our offices in Stamford, Connecticut. We welcome customer visits.

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NATURAL URANIUM AND SECONDARY MARKET CONVERSION

The **Exchange Value** as of January 31, 1985 is **$15.00** per pound U_3O_8, down $0.25 since last month. **Active supply** of natural uranium (U_3O_8 and UF_6) for spot or near-term delivery totals **4,180,000** pounds U_3O_8 or equivalent UF_6, up 540,000 pounds since last month. The corresponding figure for **active demand** is **1,265,000** pounds, up 15,000 pounds. The spot and near-term **supply-demand ratio** rose to **3.3:1.**

The *Current Market Data* section of this Report lists two uranium sales transactions, involving a total of approximately 500,000 pounds equivalent U_3O_8. One of the transactions reported this month involved low-enriched uranium, both involved deliveries before 1986, and one met the criteria for inclusion in the current Transaction Value calculation.

The **Transaction Value** as of January 31, 1985 is **$16.20** per pound U_3O_8, up $0.30 since last month. The current Transaction Value includes 14 transactions involving a total of 2.1 million pounds U_3O_8 or equivalent UF_6 and covers a period of 7 months. The Transaction Value rose as a result of dropping from the calculation June data, which included a transaction for a large quantity at a low price.

The **Loan Use Charge Rate** as of January 31, 1985 is **6 percent** per annum, unchanged since last month in a dormant market.

* * *

The Exchange Value declined for the fourth month in a row as the market for natural uranium concentrates continued to weaken. At $15.00, it has reached its lowest level since December 31, 1974. Buyers continue to hold out for the best possible terms, keeping market activity at a minimum and applying significant downward pressure on the Exchange Value. The buyer and seller indifference level, or that price range in which transactions may be completed between buyers that are willing but not pressured to buy and sellers that are willing but not forced to sell, has widened over the past several months. However, Nuexco has seen some indications of late that the gap might be narrowing; some buyers seem to be preparing to act as though they believe the market is approaching a low price plateau.

Several offers hovered below the $15.00 level, but certain contingencies applied which rendered them unfeasible. One seller chose not to sell immediately, and other opportunities involved quantities too small to be deemed significant. The typical quantity desired by buyers is something approximately equal to one reload. Quantities less than that need to be discounted substantially to overcome the buyers' reluctance to piece together several small lots to acquire the desired quantity. Substantial quantities of material remain available, both as UF_6 and as concentrates, so downward pressure on market prices continues.

* * *

The **Conversion Value** is **$1.00** per pound U in UF_6, up $0.20 since last month. One secondary market conversion transaction is reported, involving approximately 500,000 pounds U in UF_6. Active supply of secondary market conversion services for delivery within three years disappeared as the lone supplier withdrew from the market. Furthermore, one potential buyer for a large quantity has given indications of willingness to pay approximately $1.00 per pound U as UF_6 for conversion services on the secondary market. Active secondary market demand for conversion amounts to 760,000 pounds U in UF_6.

ENRICHED URANIUM AND SWUS

The Nuexco **SWU Values** as of January 31, 1985 are:

1. For **DOE origin,** a tails assay of 0.30 weight-percent U_{235}, and certifiable as excess:
   - a. For FY85 delivery, $112 per SWU, unchanged;
   - b. For FY86 delivery, $15 discount from the USEC base price on delivery, unchanged;
2. For **other** SWUs (includes DOE origin SWUs not certifiable as excess and non-DOE origin SWUs):
   - a. For delivery in calendar year 1985, $80 per SWU, unchanged;
   - b. For delivery in calendar year 1986, $90 per SWU, unchanged.

Two secondary market SWU transactions are reported, involving approximately 100,000 SWUs. One of the transactions involved low-enriched uranium.

* * *

SWU Values were unchanged this month as the lack of activity precluded a noticeable change in market prices. The market for DOE SWUs and FY85 delivery should remain open but inactive through February, until DOE announces new FY86 prices. Activity in the FY85 market has been very slow, and only a few sellers are still active. One new buyer, possibly the last FY85 SWU buyer, entered the market in January. The number of buyers interested in DOE SWUs for FY86 delivery is increasing, and they are preparing to enter the market following the DOE announcement. The timing for secondary market purchases is awkward now, because the absence of firm DOE prices for FY86 SWU makes economic comparisons difficult.

The market for SWUs other than DOE certifiable is almost dormant. Most utilities have filled all requirements until 1987, at which point the USEC allows many to fulfill 30 percent of requirements. Consequently, demand in Europe and the USA is very low. European buyers, however, are beginning to show more interest in long-term SWU purchases, most for 1987 and beyond.

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CURRENT MARKET DATA

January 31, 1985	Market Values	Active Supply[1] (thousands)	Active Demand[1] (thousands)
EXCHANGE VALUE	**$15.00**/lb. U_3O_8	4,180	1,265
CONVERSION VALUE	**$1.00**/lb. U in UF_6	0	760
SWU VALUES			
DOE origin, certifiable as excess, 0.3 tails assay			
FY85 delivery	**$112**/SWU		
FY86 delivery	**$15** discount/SWU		
Other SWUs (non-DOE or non-certifiable)			
calendar year 1985 delivery	**$80**/SWU		
calendar year 1986 delivery	**$90**/SWU		
LOAN USE CHARGE RATE	**6%**/annum	0	0

TRANSACTION VALUE

$/lb. U_3O_8	Millions of Pounds	Number of Transactions	Number of Months
16.20	2.1	14	7

[1] Supply and demand tables in the *Current Market Data* section of this Report detail the numbers for each category.

DEFINITIONS

1. The **Exchange Value** is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the date indicated.
2. The **Conversion Value** is Nuexco's judgment of the price at which spot and near-term transactions for significant quantities of conversion services could be concluded in the secondary market as of the date indicated.
3. The **SWU Values** represent Nuexco's judgment of the price at which transactions for the sale of significant quantities of SWUs of stated origin for delivery in the specified time period could be concluded as of the date indicated.
4. The **Loan Use Charge Rate** is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the date indicated.
5. The **Transaction Value** is a weighted average price of recent natural uranium sales transactions. The calculation is based on prices paid in:
   a. Transactions closed within the previous three-month period for which delivery is scheduled within one year of the transaction date;
   b. At least ten transactions;
   c. Transactions involving a sum total of at least 2 million pounds U_3O_8 equivalent.

   The sample time is extended as necessary to include these minima. Other currencies are converted to US dollars using conversion rates in effect on or near the transaction date.

DERIVATIONS AND COMMENTS

1. All Market Values are based on:
   a. Data from recently completed transactions.
   b. Data from pending transactions.
   c. Firm bids to buy or borrow, and firm offers to sell or lend.
   d. Prices purchasers or rates borrowers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy or borrow, and prices sellers or rates lenders have expressed a willingness to offer, but for which Nuexco is not aware of firm offers to sell or lend.
2. Prices associated with deliveries under old or renegotiated contracts or other than arm's-length transactions are not considered in the determination of these Market Values.
3. In the determination of the Conversion Value, Nuexco does not consider transportation charges other than those customarily provided by primary suppliers of conversion services.
4. The prices of conversion services or SWUs delivered under long-term contracts with primary suppliers are not considered in the determination of either the Conversion Value or SWU Value.
5. For the DOE SWU Values, Nuexco converts SWU prices at varying tails and product assays to equivalent SWU prices at a tails assay of 0.30 weight-percent U_{235} and a product assay of 3.0 weight-percent U_{235}, assuming feed costs corresponding to the Nuexco Exchange and Conversion Values determined as of the same date.
6. In calculating the Transaction Value, Nuexco does not account for the price of uranium delivered in connection with contracts which call for "market price" mechanisms. This exclusion applies particularly to contracts in which delivery prices are expressed as a function of future Exchange Values or any other indeterminant variable. Also excluded from the calculation are any other transactions in which the delivery price is defined in such a way that it cannot currently be determined.

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CURRENT MARKET DATA

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

	per lb. U_3O_8 in Concentrates			per kg. U in Concentrates		
Country (currency)	**This Month (Jan. 31, 1985)**	**Last Month (Dec. 31, 1984)**	**12 Months Ago (Jan. 31, 1984)**	**This Month (Jan. 31, 1985)**	**Last Month (Dec. 31, 1984)**	**12 Months Ago (Jan. 31, 1984)**
Australia (dollar)	18.38	18.37	22.33	47.78	47.77	58.06
Belgium (comm. franc)	949.37	960.33	1,177	2,468	2,497	3,061
Canada (dollar)	19.91	20.13	25.60	51.77	52.34	66.54
Finland (markka)	99.40	99.48	121.81	258.43	258.62	316.67
France (franc)	145.07	147.20	176.42	377.14	382.69	458.65
FRG (mark)	47.53	47.99	57.65	123.56	124.75	149.87
Italy (lira)	29,240	29,480	35,121	76,017	76,641	91,306
Japan (yen)	3,817	3,814	4,809	9,923	9,917	12,502
Netherlands (guilder)	53.74	54.08	64.83	139.72	140.59	168.55
South Africa (rand)	29.56	29.99	25.98	76.84	77.97	67.55
Spain (peseta)	2,628	2,638	3,250	6,832	6,857	8,450
Sweden (krona)	135.62	136.53	167.76	352.59	354.94	436.13
Switzerland (franc)	40.11	39.54	45.97	104.27	102.79	119.52
UK (pound)	13.27	13.10	14.56	34.50	34.05	37.87
US (dollar)	15.00	15.25	20.50	39.00	39.65	53.30

TRANSACTION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

	per lb. U_3O_8 in Concentrates			per kg. U in Concentrates		
Country (currency)	**This Month (Jan. 31, 1985)**	**Last Month (Dec. 31, 1984)**	**12 Months Ago (Jan. 31, 1984)**	**This Month (Jan. 31, 1985)**	**Last Month (Dec. 31, 1984)**	**12 Months Ago (Jan. 31, 1984)**
Australia (dollar)	19.85	19.16	25.11	51.60	49.80	65.28
Belgium (comm. franc)	1,025	1,001	1,324	2,666	2,603	3,442
Canada (dollar)	21.51	20.99	28.78	55.91	54.57	74.82
Finland (markka)	107.36	103.72	136.96	279.10	269.64	356.06
France (franc)	156.67	153.47	198.36	407.31	399.00	515.70
FRG (mark)	51.33	50.03	64.82	133.45	130.07	168.52
Italy (lira)	31,579	30,737	39,489	82,098	79,908	102,664
Japan (yen)	4,122	3,977	5,407	10,717	10,339	14,057
Netherlands (guilder)	58.04	56.38	72.90	150.90	146.58	189.52
South Africa (rand)	31.92	31.27	29.21	82.99	81.29	75.95
Spain (peseta)	2,838	2,750	3,655	7,378	7,149	9,501
Sweden (krona)	146.47	142.35	188.63	380.80	370.07	490.38
Switzerland (franc)	43.32	41.22	51.69	112.61	107.17	134.39
UK (pound)	14.33	13.65	16.38	37.25	35.50	42.58
US (dollar)	16.20	15.90	23.05	42.12	41.34	59.92

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[1] Calculated using currency exchange rates published in the *Wall Street Journal* on January 31, 1985.

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CURRENT MARKET DATA

CONVERSION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

	per lb. U as UF_6			per kg. U as UF_6		
Country (currency)	This Month (Jan. 31, 1985)	Last Month (Dec. 31, 1984)	12 Months Ago (Jan. 31, 1984)	This Month (Jan. 31, 1985)	Last Month (Dec. 31, 1984)	12 Months Ago (Jan. 31, 1984)
Australia (dollar)	1.23	0.96	0.65	2.70	2.13	1.44
Belgium (comm. franc)	63.29	50.38	34.46	139.53	111.06	75.98
Canada (dollar)	1.33	1.06	0.75	2.93	2.33	1.65
Finland (markka)	6.63	5.22	3.57	14.61	11.50	7.86
France (franc)	9.67	7.72	5.16	21.32	17.02	11.38
FRG (mark)	3.17	2.52	1.69	6.99	5.55	3.72
Italy (lira)	1,949	1,546	1,028	4,298	3,409	2,266
Japan (yen)	254.45	200.10	140.75	560.97	441.14	310.29
Netherlands (guilder)	3.58	2.84	1.90	7.90	6.25	4.18
South Africa (rand)	1.97	1.57	0.76	4.34	3.47	1.68
Spain (peseta)	175.19	138.36	95.13	386.23	305.03	209.73
Sweden (krona)	9.04	7.16	4.91	19.93	15.79	10.82
Switzerland (franc)	2.67	2.07	1.35	5.89	4.57	2.97
UK (pound)	0.88	0.69	0.43	1.95	1.51	0.94
US (dollar)	1.00	0.80	0.60	2.20	1.76	1.32

SWU VALUES EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	DOE SWU FY85 (January 31, 1985)	Non-DOE SWU 1985 delivery (January 31, 1985)	Non-DOE SWU 1986 delivery (January 31, 1985)
Australia (dollar)	137.22	98.02	110.27
Belgium (comm. franc)	7,089	5,063	5,696
Canada (dollar)	148.68	106.20	119.47
Finland (markka)	742.21	530.15	596.42
France (franc)	1,083	773.69	870.41
FRG (mark)	354.88	253.49	285.17
Italy (lira)	218,324	155,945	175,439
Japan (yen)	28,499	20,356	22,901
Netherlands (guilder)	401.29	286.64	322.47
South Africa (rand)	220.69	157.64	177.34
Spain (peseta)	19,622	14,015	15,767
Sweden (krona)	1,013	723.33	813.74
Switzerland (franc)	299.47	213.90	240.64
UK (pound)	99.07	70.77	79.61
US (dollar)	112.00	80.00	90.00

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[1] Calculated using currency exchange rates published in the *Wall Street Journal* on January 31, 1985.

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CURRENT MARKET DATA

RECENT TRANSACTIONS[1]

Uranium Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds U_3O_8 equivalent)	Approximate Price as Percent of Current E.V.	Seller	Buyer	Remarks
3291A	1985	301-600	R[2]; see remarks	European Utility	US Fabricator	LEU (assumes 0.3% tails assay). Not an arm's length transaction.
3269	1985	101-300	103	US Producer	US Utility	

[1] Transactions listed are not limited to those in which Nuexco was involved, but also include others of which Nuexco is aware.

[2] The notation *R* means that Nuexco either does not know, or that Nuexco has restricted that information to protect client confidentiality.

Secondary Market Conversion Services

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U equivalent)	Approximate Price as Percent of Current C.V.	Seller	Buyer	Remarks
3288	1985	300-601	100	US Utility	European Utility	

Enrichment Services
Secondary Market Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity[2] (thousands of SWUs)	Approximate Price[3] as Percent of Current SWU Value[4]	Seller Group	Buyer Group	SWU Origin	Remarks
3291B	1985	50-100	R[5]	European Utility	US Fabricator	R[5]	LEU (assumes 0.3% tails assay). Not an arm's length transaction.
3264	1985	less than 50	91	R[5]	European Utility	DOE	Occurred in late 1984.

[1] Transactions listed are not limited to those in which Nuexco was involved, but also include others of which Nuexco is aware.

[2] If tails assay is unknown or unspecified, Nuexco's calculation of SWU quantity assumes 0.30 w/o tails assay.

[3] Price is not normalized to 0.30% tails assay.

[4] Refers to SWU Value that corresponds to SWUs included in transaction. When prices and SWU values are expressed as discounts (e.g., X dollars less than DOE's USEC base price at time of delivery), the percentage refers to the ratio of the *discounts*, not the ratio of the prices.

[5] The notation *R* means that Nuexco either does not know, or that Nuexco has restricted that information to protect client confidentiality.

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CURRENT MARKET DATA

URANIUM SUPPLY
(January 31, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8)		Remarks
	Spot or Near-term[2]	Intermediate or Long-term	
Available for Sale:			
ACTIVE			
1575	500	500 per year	
1860	400	1,500 per year	
2038	1,000	1,000 per year	UF_6
2134*	220	220 per year	1986-87
2236*	200	200 per year	1986-89
2288A	40	—	
2288B	295	—	UF_6
2389*	200	—	
2392	35	—	UF_6
2499	15	—	
2516	200	—	
2538*	35	—	
2538A*	130	—	UF_6
2565	400	—	
2569	200	—	
2584*	300	—	
2603*	10	—	
2263	—	500 per year	1985-90
2625	—	300 per year	1988-97
2657*	—	980	1986; UF_6
TOTAL:	4,180		
INACTIVE			
2191	125	—	UF_6
2275	150	—	
2335	275	—	
2336	250	250 per year	1985-94
2495	130	—	UF_6
2509	1,200	1,600	UF_6
2553	300	—	
2664*	250	250 per year	UF_6
0564	—	1,000 per year	1985-90
2271	—	500 per year	1985-88
2297	—	200 per year	1986-89
2326	—	1,000 per year	1989-91
2368	—	250 per year	1987-90
2514	—	1,000 per year	
2574	—	500	UF_6
TOTAL:	2,680		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2473.

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CURRENT MARKET DATA

URANIUM DEMAND
(January 31, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Spot or Near-term[2]	Delivery Period[1] (Thousands of Pounds U_3O_8) Intermediate or Long-term	Remarks
Inquiries to Purchase:			
ACTIVE			
2457A*	130	—	
2548	300	—	
2590	475	—	U_3O_8 or UF_6
2636*	200	—	
2690*	160	—	
2217	—	1,000 per year	1989-95
2442	—	4,000	1986-95
2507	—	600	1987-89
2540	—	400 per year	1989-94
TOTAL:	1,265		
INACTIVE			
2329	500	—	1985
2576	20	—	UF_6
2638*	350		UF_6
1999	—	50 per year	1986-90
2244	—	350 per year	1987 on
2414*	—	365	1987-88
2457B*	—	650	1987
2586	—	300	1987
2643	—	150 per year	1987 on
2674*	—	1,000	
TOTAL:	870		

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*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.
Projects removed since last month: 2533, 2419B.

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CURRENT MARKET DATA

CONVERSION SUPPLY AND DEMAND
(January 31, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U as UF_6) Within 3 Years	Beyond 3 Years	Remarks
Available for Sale:			
ACTIVE			
TOTAL:	0		
INACTIVE			
2051	1,000	—	
2438	500	250 per year	1986-87
2511	600	700	1986-90
TOTAL:	2,100		
Inquiries to Purchase:			
ACTIVE			
2602*	460	—	
2638A*	300	—	
TOTAL:	760		
INACTIVE			
2644*	—	475	1987 on
2587*	285	—	
TOTAL:	285		

*New or revised since last month.

[1] Measured from the date of this Report.

Projects removed since last month: 2141.

LOAN SUPPLY AND DEMAND
(January 31, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Within 1 Year	Beyond 1 Year	Remarks
Available for Loan:			
INACTIVE			
1938	2,000	—	UF_6
2128	700	—	
2139	2,000	—	
2469A	800	—	
2483	550	—	
TOTAL:	6,050		

*New or revised since last month.

[1] Measured from the date of this Report.

No inquiries to borrow this month.

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URANIUM DEMAND
(March 31, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Spot or Near-term[2]	Delivery Period[1] (Thousands of Pounds U_3O_8) Intermediate or Long-term	Remarks
Inquiries to Purchase:			
ACTIVE			
2419*	130	—	UF_6
2548*	290	—	
2574B*	640	—	UF_6
2590*	75	—	U_3O_8 or UF_6
2636	100	—	
2659*	250	—	
2661	260	260 per year	1986-87
2674*	800	—	
2676*	100	—	UF_6
2690	160	—	
2995*	1,250	—	UF_6
2217	—	1,000 per year	1989-95
2442	—	4,000	1986-95
2507	—	600	1987-89
2540	—	400 per year	1989-94
2611*	—	130 per year	1987-88
2681*	—	1,000 per year	1987-88
2694*	—	625	1987; UF_6
TOTAL:	4,055		
INACTIVE			
2576	20	—	UF_6
2244	—	350 per year	1987 on
2414	—	365	1987-88
2457B	—	650	1987
2586	—	300	1987
2643	—	150 per year	1987 on
TOTAL:	20		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 1999, 2329.

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CURRENT MARKET DATA

LOAN SUPPLY AND DEMAND
(March 31, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Within 1 Year	Beyond 1 Year	Remarks
Available for Loan:			
INACTIVE			
1938	2,000	—	UF_6
2128	700	—	
2139	2,000	—	
2469A	800	—	
2483	550	—	
2667	800	—	
TOTAL:	6,850		

CONVERSION SUPPLY AND DEMAND
(March 31, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U as UF_6) Within 3 Years	Beyond 3 Years	Remarks
Available for Sale:			
ACTIVE			
2051*	110	—	
TOTAL:	110		
INACTIVE			
2438	500	250 per year	1986-87
2511	600	700	1986-90
TOTAL:	1,100		
Inquiries to Purchase:			
ACTIVE			
2419A	55	—	
2602	200	—	
2617*	—	275	1986-91
TOTAL:	255		
INACTIVE			
2529	225	—	
2587*	70	—	
2644	—	475	1987 on
TOTAL:	295		

*New or revised since last month.
[1] Measured from the date of this Report.
Projects removed since last month: None.

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SWU SUPPLY
(March 31, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of SWUs) Spot or Near-term[2]	Intermediate or Long-term	Remarks
Available for Sale:			
ACTIVE			
2100	150	100 per year	
2359*	—	200	
2624	100	—	
2631	150	—	
2633B	330	—	
2664	150	—	
2285	—	300	
2513	—	25	1986
2517*	—	155	1986-89
2571	—	55	1987
TOTAL:	880		
INACTIVE			
2164*	20	—	
2378	—	120	1988
2510	—	50	
2652	—	25	1986
TOTAL:	20		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes SWUs deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2583, 2657A, 2689.

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CURRENT MARKET DATA

SWU DEMAND
(March 31, 1985)

	Delivery Period[1] (Thousands of SWUs)		
Nuexco Project Number	Spot or Near-term[2]	Intermediate or Long-term	Remarks
Inquiries to Purchase:			
ACTIVE			
2655	10	—	
2400*	—	150	1987-90
2519	—	30 per year	1987 on
2578	—	100	1986
2653	—	100	1986-90
2658	—	5	1986
TOTAL:	10		
INACTIVE			
2543	25	25	1986
2585*	—	40	1986
2500*	—	170	1988
2512	—	15 per year	1987 on
2595	—	50	1986
2693*	—	100 per year	1989-90
TOTAL:	25		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes SWUs deliverable within one year under other than spot or near-term contracts.
Projects removed since last month: 2665, 2669.

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PRIVATIZATION AND THE COMPETITIVENESS OF US ENRICHMENT SERVICES

by Dr. Karl P. Cohen

The following is a presentation made by Dr. Karl Cohen at the Atomic Industrial Forum's Fuel Cycle Conference in New Orleans on March 13, 1985. Dr. Cohen's distinguished record in the field of nuclear energy includes major contributions to the theory of isotope separation and the methodology of gaseous diffusion and centrifugal separation. He received the 1979 Chemical Pioneer Award of the American Institute of Chemists for his theory of gas centrifuges. This presentation is reprinted by permission.

Introduction

In 1973, the US nuclear power program was projected to attain 1,200 GWe by the turn of the century. It is now projected to reach only 110 GWe (Table 1). The uranium enrichment industry, which presently has little other purpose than to supply fuel for nuclear power plants, must obviously be profoundly affected. We are not looking here at minor changes, which might be accommodated by a change in style of doing business, however desirable that might be. We are looking at order-of-magnitude changes. We are looking at an earthquake. What is called for is a complete reappraisal of the fundamental purposes and structure of the US uranium enrichment program, including our objectives in serving the domestic and international uranium enrichment markets by a government-managed enterprise.

Table 1

US ENRICHMENT ENTERPRISE CAPACITIES[1]
(Millions of SWUs per year)

	1973	1985
Capacity	17	27
Planned Capacity	10	13
Production	10	10
Projected domestic market in the year 2000	100	12
Projected off-shore market in the year 2000	100	30
Off-shore market share in percent	100	37

[1] Free World only.

You will have recognized that this call for a reappraisal of the goals of our enrichment program bears some resemblance to the conclusion of the Comptroller General in his recent report to former Congressman Ottinger on the new Utility Services Contract. There are however significant differences. I do not consider it *a priori* evident that serving the international market should be a primary objective, that pricing by itself will be sufficient to achieve it.

At present, fuel accounts for 20 to 30 percent of the generating cost of nuclear power (the lower value is in the USA, where capital costs are high). About one-third of this cost comes from the enrichment process. Thus enrichment contributes only 7 to 10 percent of nuclear power costs, while capital charges account for 50 to 70 percent. To a plant owner, assurance of supply of enriched uranium has five to ten times the economic weight as the price of enrichment itself. But the supply of enriched uranium from the USA is conditional on political concessions which are not only burdensome but subject to unilateral change. This has made the USA the enrichment supplier of last resort in the only market which still has vitality—the off-shore market. To breathe new life into the US enrichment enterprise we shall have to look at more than the technology, and more than the price. We shall have to examine some of the unwanted side-effects of that sacred cow of American politics, the nuclear non-proliferation policy.

The parallel between the difficulties of the enrichment enterprise and the difficulties of the US nuclear power industry has certainly not escaped this audience. The recent Forbes article concludes that a reform of our institutions, more than of our technology, is the prerequisite for a rebirth of the nuclear option in the US. Similarly, important as technology is in uranium enrichment, a purely technological fix is not available to us. We have to take into account the management of the enterprise, and the policies and institutions which constrain it.

Let me refer you back for a moment to the data in Table 1. It is clear that a pricing formula which might be perfectly reasonable in 1973 could be wildly inappropriate in 1985. The GAO letter, and the Congressional inquiry which precipitated it, illustrate, if further illustration were necessary, the intrinsic difficulties of government management of uranium enrichment, and the desirability of serious consideration of privatization.

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ANALYSIS & COMMENTARY

Objectives

Table 2 presents a number of possible objectives for the enrichment enterprise. At first glance, it might seem that all the objectives are desirable, and that all can be attained. However, this is only possible in a monopoly situation. For example, the virtue of the first objective, assuring domestic fuel supply, seems almost self-evident. It is a parallel to the requirement of the Atomic Energy Act that a viable domestic uranium industry be maintained. But other countries, many of whom have a far greater percentage commitment to nuclear electricity than we do, are likely to think the same way. If we are prepared to pay more for uranium from low-grade American ore, will they not be willing to buy enrichment services from their local enrichers, even at a premium? Assurance of supply by supporting domestic producers is a doctrine which, if adopted universally, is likely to frustrate the achievement of Objective 4. The continued interest in new enrichment programs—for example, Japan, Brazil, South Africa and Argentina—despite the world glut of separation capacity and overhanging enrichment inventories, points in this direction.

Table 2

POSSIBLE ENRICHMENT ENTERPRISE OBJECTIVES

1. Assure fuel supply for domestic reactors.
2. Maintain capability to produce HEU for military.
3. Maximize off-shore sales of reactor equipment by advantageous terms for enriched fuel.
4. Maximize off-shore market by low prices to support US non-proliferation policy.
5. Maximize market share by low prices to increase cash return.
6. Maximize profit.

The second objective introduces two new questions. The first is whether the production of HEU should ever be privatized. This might be resolved by splitting out the high enrichment cascade from the rest of the plant and retaining it as a separate, government-owned entity. This leads naturally to the issue of whether a privatized enrichment enterprise should be in one piece or split into several. Arguing for one piece are the extraordinarily high capital requirements of enrichment plants, capital which could be raised on most favorable terms by a regulated monopoly. A regulated monopoly could write long-term exclusive contracts, also helpful in raising capital, without running afoul of the anti-trust laws. Arguing for several pieces are the benefits of competition, and the relative ease of introduction of new technology.

The last four objectives are somewhat inconsistent, since it is unlikely that one can maximize them simultaneously. During the period of American monopoly of uranium enrichment facilities, maximizing off-shore sales of nuclear reactors and supporting US non-proliferation policy were not obviously incompatible. However, American supply of enriched uranium was accompanied by restrictions on use or disposal of the spent fuel. These were not acceptable to the Europeans, and were a determining factor in our ultimate loss of the enrichment monopoly. The passage of the Nuclear Non-Proliferation Act of 1978, which contains clauses encouraging the use of solar and renewable energy rather than nuclear power, and discouraging the reprocessing and recycling of spent nuclear fuel, has effectively eliminated the third objective. Nobody can possibly believe that the object of the coalition that passed the Act was to foster nuclear power in any country. The present policy of DOE is a combination of objectives 4 and 5, namely, maximizing the market share by lowering prices, to increase cash flow and also to support US non-proliferation policy. Increasing cash flow is the driving force. Supporting non-proliferation policy is a constraint. It should be noted that the erosion of the US off-shore market share began *before* the rise of the dollar, while we still had price leadership. Thus the policy seems unlikely to succeed without ruinous price concessions. It reminds me of the legendary wholesaler who lost on each sale, but made it up on volume.

The last objective is maximizing profit. Unless this is taken as the primary objective, privatization is only a slogan, not a real option. Maximizing profit might require a very different approach to the market. The approach might be to set terms and prices to suit the domestic market (where there is a preference for US supply), rather than to obtain the maximum off-shore market; to shut down and write off excessive and high cost production facilities; to evaluate technical options on a total cost and not a forward cost basis; to control costs by eliminating excessive contractors and excessive personnel; and to share the benefits of lower cost advanced technologies by improving profits as well as lowering prices. Such an approach would require unified marketing but could in the long run accommodate competitive producing units.

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Further Observations on Privatization

The current invitation of DOE for private industry to invest in the AGC and the AVLIS processes is directed at solving DOE's immediate financial problem without altering the Department's management of the projects. The capital intensity of uranium enrichment is unusually great. The government is in fact the appropriate source of capital or credit. The financial problem has arisen by a combination of delayed management response to the rapidly changing market conditions, and hostile Congressional oversight. Industry has no place volunteering to be the lender of last resort, merely because ideologues in and out of Congress impose unreasonable constraints on the finances and the policies of the enrichment enterprise.

What should be privatized is not the *financing*, but the *management* of the uranium enrichment enterprise. This Administration, (and previous ones as well), have favored this procedure for organizations as diverse as the Post Office, the Federal National Mortgage Association, and the Tennessee Valley Authority.

The last major effort at privatization of enrichment peaked in the period 1975-76 with the debate on (and defeat of) the Nuclear Fuel Assurance Bill. At the time, the late Craig Hosmer suggested that a government corporation would be a more acceptable alternative. I believe his idea has considerable merit. Such a corporation would isolate the enrichment enterprise from the annual Congressional budget process. It could offer bonds like TVA, and allow investment to be offered based on the needs, and supported by the revenues, of the enrichment business alone. The Board of Directors should be larger than that of TVA, and include outside directors who would represent the insights and interests of other segments of the nuclear industry, notably (but not exclusively) the utilities and the uranium miners.

To establish such a corporation, new legislation would be necessary. The debate on such legislation would furnish an opportunity to forge a consensus on the *objectives* as well as the *structure* of the corporation, and might be an important step in the public education needed for a rebirth of the nuclear industry.

The Economic Competition

Economic comparisons between plants in different countries are very hazardous. Plant capital costs, even if fully reported, are in different currencies. Inflation and interest during construction depend on local circumstances and schedules. They are not strictly comparable, and they are seldom fully reported. The capital charge rate applied depends on details of the financing, generally considered a commercial secret, and the local accounting rules. In the US enrichment plants, the capital charge is the imputed interest rate, which rises and falls from year to year with general interest rates. Inventories of natural and enriched uranium may be large or small, depending on policy and history. The inventories may be valued at acquisition costs (themselves variable), or otherwise. The cost of maintaining inventory may be calculated in the same way as the cost of fixed capital, or differently. Finally the utilization factor—the fraction of the plant capacity which is actually used—is an overall divisor into the capital charges.

Of the operating costs, labor rates and productivity vary from one country to the next. In the gaseous diffusion process, the pricing formulae reveal that half the price is proportional to the cost of power. The power costs depend on contract arrangements with particular suppliers, whose demand and energy charges are not uniform. While these are published in the US, they are not readily available elsewhere. Plant managers, depending on production requirements, may schedule operations at off-peak hours, thus obtaining better rates. Thus, Eurodif plans to operate only during the seven summer months when power costs are lower.

Translating costs from one currency to another introduces another uncontrollable factor. Over the past four years the dollar has risen approximately 40 percent against a basket of 15 foreign currencies, and even more spectacularly—150 percent—against the French franc. Most observers believe the dollar is at a cyclical high and will come down. I do not know of any accepted economic theory which defines "equilibrium" exchange rates, but it seems unlikely that the dollar will fall below its 1980-81 values, when it was at a cyclical low. In most of the economic comparisons, I use the low values, to show that our present lack of cost and price leadership will not disappear with the next exchange rate fluctuation.

It is clear that the long-range competitiveness of the US Gaseous Diffusion Plant is not determined by the temporary embarrassment of an unfortunate power contract which imposes high demand charges for power not used. Just as clearly, it cannot be measured by the price of a particular block of kWh purchased over a summer weekend. We must bring in more fundamental considerations. What appears to be really relevant is the average bus-bar cost of electric energy to all US industry. We must face the fact that the US utility industry has fallen behind the rest of the world in its ability to build new capacity economi-

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cally. The capital costs of any new generating capacity are so high that we are witnessing a virtual moratorium on new plant construction. In a situation where new capacity costs more than installed capacity, lower prices to one industry mean higher prices and less competitiveness for another.

When push comes to shove, the ultimate measure of competitiveness of gaseous diffusion plants will be their out-of-pocket costs for additional SWUs. Figure 1 shows the situation as of April 1, 1984. Eurodif uses about 13% more kWhs per SWU than our plants, but our kWhs cost about 50 percent more than theirs. Table 3 looks further ahead to 1990. Notice that the French total power cost is projected to be two-thirds of ours and their energy cost one-half, using 1981 exchange rates. In 1981, the franc was about 20 cents. The bottom line is my speculation on the generating costs of a Siberian hydro plant which would be feeding current to a Russian diffusion plant. The conclusion seems inescapable that our superior diffusion technology is not enough to compensate for the difficulties of our power industry. We will not regain price leadership with an energy-intensive process.

Figure 1

WORLD INDUSTRIAL AND COMMERCIAL ELECTRICITY PRICES AS OF APRIL 1, 1984[1]
(Pence per kilowatt-hour)

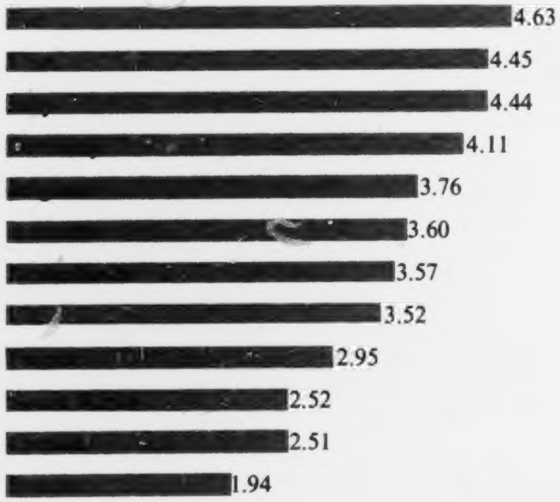

Table 3

LEVELIZED DISCOUNTED GENERATION COSTS 1990 PLANTS
(Jan. 1, 1981 cents per kWh)
(discount rate 5 percent)

Country	Capital	O & M	Fuel	Total
France (Nuclear)	1.02	0.36	0.69	2.07
USA (Coal)	1.03	0.37	1.52	2.92
USSR (Hydro)	?	?	0.00	1.00

Source: OECD, September 9, 1983.

Table 4 gives the approximate status of the competition in centrifuge technology, given in 1980 dollars. In addition to the difficulties mentioned above of comparing costs in different countries, note that none of these plants has actually been completed and operated. Prudence suggests a further reserve about what the numbers will be when the plants are on-line. However, Urenco has already built and operated some plants, and half the Portsmouth plant is already in existence, so the rankings have some credibility. Let me remind you again that these rankings are in 1980 dollars. Since then, the mark has dropped from 50 cents to 30 cents. At present exchange rates, the German and American technologies would appear to be neck-in-neck.

I have not prepared a table on the economics of the AVLIS process, since I have no confidence in my ability to project the capital and operating costs of the process when (and if) it is realized. Since many other nations are,

Table 4

THE CENTRIFUGE COMPETITION
(1980 dollars)

Technology	Capital $ per SWU per year	Power $ per SWU	O & M $ per SWU
US Set III	660	2	22
Urenco 1985[1]	500	2	11
US Set V	330	2	11

[1] Gronau, FRG.

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[1] This figure is a reproduction of a figure presented in *Nuclear Europe*, Volume 10, October 1984, in an article by G. Ekberg, L. Fogelstrom and L. Gustafsson entitled "Nuclear Power Production in Sweden." Source: National Utility Services.

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as they should be, interested in laser isotope separation, I do not doubt that we shall face strong competition in this technology as well.

Conclusions

It is time for us to discard the notion, which is a holdover from the years of American monopoly of uranium enrichment supply, that we have guaranteed technical superiority in all branches of isotope separation; and that this technical and economic superiority is so great that we can impose terms and conditions on our enrichment supply without regard to the preferences of our customers, or the alternatives available to them. We do have, indeed, the largest surplus enrichment capacity in the world, burdened with the highest energy costs. It is not plain why this is an advantage.

The last addition to the US gaseous diffusion plants increased the capacity over the years 1974 to 1982 by 10.1 million SWU per year, at a cost of 1.5 billion nominal dollars. Over roughly the same period, Eurodif built a green field plant of 10.8 million SWU per year, at a cost of 16 billion francs. No matter how one translates from francs to dollars, this is a respectable achievement. The French have developed a chemical exchange process for uranium enrichment, which we were unable to do. The inventor of the basic design of the modern gas centrifuge is still consulting for Urenco. This is not a time for complacency, still less for cutting back on research and development, as I was horrified to see embodied in the justification furnished for our new contract price of $135/SWU.

We also need, not *business-like* management, but *business management,* free to choose and fight for realistic goals, and free to make the hard decisions which will be required to implement them. In the long run, privatization will probably be required to achieve our objectives. Establishment of a government corporation is the essential first step.

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RECENT DEVELOPMENTS

GREECE

The Greek Institute of Geological and Mining Research (IGME) has announced the existence of a uranium production pilot plant in Paranesti, in northern Greece. The plant's construction was funded jointly by the Greek government and the European Economic Commission (EEC), and has been in operation since November 1984. IGME conducts exploration in the area and operates the pilot plant.

IGME began extensive survey operations at Paranesti in 1980, although the existence of uranium deposits in the area was documented in the early 1960s. IGME has estimated reserves at several million tonnes, and plans to issue a revised reserves estimate in the coming months. While the government's official energy plan does not mention nuclear power, the Energy Minister stated that known uranium reserves are capable of providing fuel for a 600-MWe reactor for 35 years, and the issue was now under study.

JAPAN

Kansai Electric Power Co. recently completed the planning phase for two additional 1,180-MWe PWRs, Ohi Units 3 and 4, to be located at the current Ohi site. In its first approval action for new nuclear generation facilities in 22 months, the government's Electric Power Resources Development Coordination Council (EPRDCC) granted approval to plans for the two units and officially recognized them as projects (see Report 188, April 1984, for Japan's nuclear plant licensing procedure). Kansai Electric is now prepared to submit plant designs and safety analysis for construction/operating license approvals. Commercial operation dates for the two units are scheduled for 1991 and 1992, respectively.

Similar EPRDCC approval is expected shortly for Tokyo Electric Power's Kashiwazaki Units 3 and 4, each 1,100-MWe BWRs, with commercial operation scheduled for 1993 and 1994 respectively. Chubu Electric also announced it was planning its next plant, Hamaoka Unit 4, which probably will be an 1,100-MWe BWR. A commercial operation date for the plant has not been established.

* * *

Plans for location of new enrichment, reprocessing and low-level waste storage facilities at a common location are proceeding as scheduled (see Report 193, September 1984). The governor of Aomori Prefecture, the proposed location of the facilities, announced his approval of the projects, subject to final endorsement by the prefectural assembly, expected by the end of March.

The Power Reactor and Nuclear Fuel Development Company (PNC), which developed centrifuge technology for the planned enrichment facility, also will provide reprocessing technology for the planned reprocessing facility, to be operated by Japan Nuclear Fuel Services (JNFS). PNC, under a national development program, has built and operated since 1980 an 0.7-ton-per-day demonstration reprocessing plant at Tokai Mura. The plant sustained a series of dissolver failures in 1982 and 1983, and has operated only intermittently. Dissolver repair and replacement programs recently were completed. The plant now is scheduled to return to normal operations in April. An initial goal to process 70 tons of spent LWR fuel from domestic reactors has been established. Several other developments in plans for recycling plutonium and depleted uranium have occurred in recent months:

1. Japan Atomic Power Company (JAPC) has received license approval to load two mixed-oxide fuel bundles into Tsuruga Unit 1, a 357-MWe BWR, for test purposes. In a separate study, government agencies have suggested that the utilities should plan to load mixed-oxide fuel into ten LWR units by 2000.

2. PNC successfully performed test enrichment of depleted uranium produced by its Tokai Mura reprocessing facility. PNC is proposing that the utilities support construction of a facility to re-enrich 20 to 100 tons of depleted uranium annually to demonstrate the technology.

3. PNC recently announced new cost estimates for its often-delayed, 280-MWe demonstration FBR now scheduled for operation in the mid-1990s. The current estimate exceeds $2.3 billion, a 50-percent increase from the 1979 estimate.

* * *

Japanese utilities have concluded annual price negotiations for deliveries under long-term uranium supply contracts with African and European suppliers. The utilities agreed to pay approximately $32 per pound U_3O_8 for 1986 deliveries (fiscal year ending March 31, 1986), a reduction of $1.00 to $1.50 relative to the price paid for 1985 deliveries.

The annual price negotiations are influenced greatly by developments in the spot and near-term prices over the previous year, as opposed to the months immediately preceding the negotiations. Thus, the spot/near-term prices paid in May or June 1984, when the Exchange Value was $17.75, probably had as much influence in determining FY86 long-term prices as did spot/near-term prices paid

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in February or March 1984, when the Exchange Value was $15.00.

The downward pricing trend for long-term price agreements has slowed considerably in the last few years, falling only $3.50 since FY83. Table 5 shows a comparison for the past six years of annually negotiated prices versus average Exchange Values, which have declined at a much greater rate.

Table 5

RESULTS OF ANNUAL JAPANESE URANIUM PRICE NEGOTIATIONS COMPARED TO EXCHANGE VALUE

Fiscal Year Ending March 31	Approximate Agreed Price ($/lb. U_3O_8)	Average E.V. for Preceding Japan FY (1980-85) ($/lb. U_3O_8)	Delivery Price/ Average E.V.
1981	45.00	41.17	1.1
1982	37.75	28.63	1.3
1983	35.50	23.65	1.5
1984	33.70	19.65	1.7
1985	33.50	22.10	1.5
1986	32.00	16.44	1.9

UNITED STATES

Several NRC reactor licensing actions took place in the last few months. Middle South Utilities, Inc. received a full-power license for its Waterford plant, a 1,104-MWe PWR. Commonwealth Edison received a low-power license for its Byron Unit 1, the first of two 1,120-MWe PWRs at the site. Kansas Gas and Electric Co. received a fuel-loading and low-power-testing license for its Wolf Creek plant, a 1,150-MWe PWR. Detroit Edison also received a fuel-loading and low-power-testing license for its Fermi Unit 2. Commercial operation for all four units is expected in 1985. In addition, Diablo Canyon Unit 1 reached 100-percent power in March, and is delivering 1,100 MW to the Pacific Gas & Electric grid. An inquiry by the California Public Utilities Commission has begun to determine how much of the $4 billion plant should be allowed into the rate base.

On the negative side, the low-power license granted to Long Island Lighting Company's (LILCO) Shoreham plant (see Report 199) was revoked by the Atomic Safety and Licensing Board. The 820-MWe BWR had received NRC permission to begin low-power operation only one week before. The Board revocation was based on the NRC requirement that the plant have a safe source of backup power. An NRC licensing board had bypassed that requirement by recommending that LILCO be granted an exemption. The plant's backup diesel generators are inoperable, but LILCO had submitted a plan involving smaller generators.

LILCO's emergency plan also was rejected by a New York state court, demonstrating Suffolk County's unwillingness to grant the utility authority normally wielded by state and county police in case of emergency. It now is clear that the utility will be unable to implement any emergency plan without the cooperation of local authorities, posing yet another obstacle to Shoreham's operation.

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AMPLIFICATIONS

CORRECTION

Three errors appeared in Part 2 of the Optimum Tails Assay article in Report 196 (December 1984).

1. The incremental values of the horizontal axis on Figure 1, page 14, were printed incorrectly, resulting in a misleading curve. The correct figure is reprinted below.

2. In the Appendix to the article, beginning on page 18, the implicit equations contained two errors. In the B′ equation, the (Cost Ratio) should be divided by Y, where Y equals (0.86 + 0.7 × Tails w/o) if the VTAO charge applies. (Y equals 1 if no VTAO charge applies.)

In the S equation, one component of the denominator should be (0.86 + 0.7 × Tails w/o), instead of (0.86 − 0.7 × Tails w/o).

For clarification purposes, the entire Appendix is reprinted below, with the correct equations.

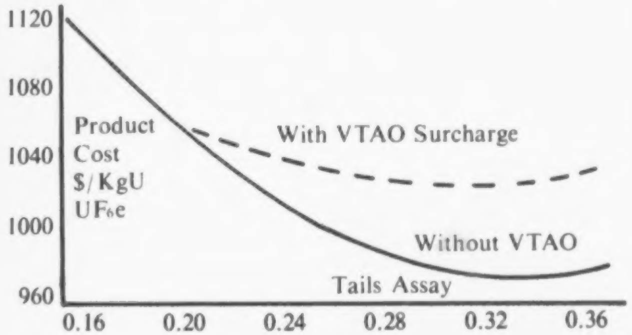

Figure 1. Cost of 3.50 w/o Product as a Function of Tails Assay for Feed at $50/KgU and Enrichment at $135/SWU.

Appendix

Tails Assay for Minimum Product Cost with Maximum VTAO Surcharge

The following series of implicit equations can be solved by iteration on a computer or programmable calculator. In this series of equations, the feed is assumed to be 0.711 w/o, and the assays are in units of weight percent, in contrast to the other equations in this article which use assay as weight fractions (weight percent = weight fraction × 100).

$$A = (\text{Tails w/o} \,/\, 50 - 1) \times (0.711 - \text{Tails w/o})$$

$$B' = 4.868883 - (\text{Cost Ratio}) \,/\, (0.7 \times \text{Tails w/o} + 0.86) + 0.985780 \times \text{Ln}\,[\text{Tails w/o} \,/\, (100 - \text{Tails w/o})]$$

$$S = 0.7 \times \text{SWU Factor} \times (0.711 - \text{Tails w/o})^2 \,/\, [(\text{Enrichment w/o} - 0.711) \times (0.86 + 0.7 \times \text{Tails w/o})]$$

$$\text{Tails w/o} = A \times 100 \,/\, [(100 - \text{Tails w/o}) \times (B' - S)]$$

The above relationships assume a VTAO credit for tails assays less than 0.2 w/o. As a result, they are incorrect for tails less than 0.2 w/o, and must be adjusted to the lesser of 0.2 w/o or the tails assay for minimum product cost without the credit (Report 195).

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URANIUM DEPOSITS IN THE USSR

Introduction

The USSR began developing nuclear power in the late 1940s. Recognized as a favorable alternative for electricity generation, nuclear power plants appeared well-suited for the highly populated regions of western USSR, which are far removed from natural energy resources in Siberia. Construction of the first nuclear generating plant (a 100-MWe liquid graphite reactor) began in early 1950; it was completed and operating in 1954, becoming the world's first nuclear power plant. Nuclear industry development continues in the USSR, although bureaucratic, engineering and construction problems during the mid-1960s, late 1970s and early 1980s have disrupted and delayed the program. The original construction schedule called for a generating capacity of over 50,000 MWe by 1985; actual installed capacity, however, totaled approximately 23,000 MWe at the end of 1984.

A recent announcement by the State Committee for Atomic Energy (GKAE) indicated that nuclear plant construction would be accelerated to increase generating capacity by 40,000 to 60,000 MWe in the mid-1990s, in order to accommodate an annual power growth rate of four percent. If this goal is achieved, approximately 60 percent of the USSR's electricity will be produced by nuclear energy. The program to increase nuclear generating capacity will require the expansion of all phases of the future U_3O_8 requirements, and exploration for new ore deposits along with the development of known deposits has accelerated.

Limited information concerning uranium deposits in the USSR is available from Soviet sources; that information is often limited to deposits which have been developed for industrial purposes. Soviet documentation offers geologic descriptions of certain deposits in considerable detail, while others, thought to be major deposits, are not specified. Ore reserves and percent of uranium content are never cited. Geologic setting and ore genesis are often described, indicating the wide variety of uranium occurrences. The geographic locations of most deposits usually are not described. Association by geologic setting is the principal method Western geologists use to establish location. Still, the location of certain deposits may be only approximate at best. There is even less documentation regarding ore body development and recovery technology.

The *Raw Materials* section of Report 194 (October 1984) examines uranium ores in the Zholtye Vody district of the Ukraine.

Classification of Uranium Deposits

Uranium occurrences in the USSR correspond to many known occurrences in the western world. Significant exceptions are the absence of large-tonnage Precambrian quartz-pebble conglomerates similar to the Witwatersrand Basin of South Africa and the Elliot Lake district of Ontario, Canada, and Proterozoic unconformity-related deposits in the Northern Territory of Australia and the Athabasca Basin of northern Saskatchewan, Canada. However, Soviet geologists remain optimistic that important deposits in both types of geologic environment will be discovered eventually.

Uranium occurrences in the USSR generally are classified by vein-type and hydrothermal mineralization. Vein deposits are associated mainly with intrusive and metamorphic rocks; hydrothermal deposits are associated directly with sedimentary rocks, from sandstones to shales, and coal beds. Uranium deposits are subdivided into four basic series. Each series is further divided into classes and specific types of deposit.[1]

1. The *series* of the deposit is determined by geologic position and age, as well as genetic relationship;
2. The *class* of deposit is established by mineralogy, structural form and association with surrounding host rocks;
3. The *type* of deposit depends on the local geologic features controlling mineralization. A total of 16 types of ore deposits have been described. Table 6 lists and briefly describes each type.

Conclusion

Figure 2 illustrates the location of many important uranium districts and production centers in the USSR. Uranium is produced (or has been produced) from all 16 types of deposits listed in Table 6, although the actual importance of each to the uranium supply program is unknown. Certain types of deposits have not contributed to U_3O_8 requirements, while others have served as a main supply. The principal differences between deposits are total tonnage available, contained U_3O_8, accessibility to mining, and favorable metallurgy.

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[1] Kazanskiy, V. I., and Laverov, N. P., *Mestorozhdienia Urana (Uranium Ore Deposits)*—Nedra, Moscow, 1974.

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Table 6

URANIUM ORE CATEGORIZATION IN THE USSR

SERIES A. *Metamorphogenic deposits of ancient platforms.* Uranium mineralization in Precambrian basement intrusives and metamorphic rocks. Tectonic and metasomatic zones contain important vein deposits.

Type 1. *Iron-uranium mineralization associated with sodium and carbonate-rich metasomatites.* Intrusions and folding influenced placement of ore in lower conglomerates, middle hematite-magnetite zones, and upper graphite schists and dolomitic marbles.

Type 2. *Uranium associated with sodium-rich metasomatic rocks.* Ore minerals occur in elongated folds at basement contacts. Host rocks are the iron formation, migmatites and mylonites.

SERIES B. *Endogenic deposits of fold regions.* Ore associated with volcano-intrusive rocks in deep-seated geosynclinal fold belts.

Class I. *Hydrothermal minerals in andesites-diorites.* Uranium-molybdenum minerals in both rock types, associated with post-orogenic hydrothermal activity.

Type 3. *Uranium associated with dikes.* Diorite dikes associated with syenite intrusives cut lower sedimentary rocks. Ore is in conglomerates, sandstones and argillites.

Type 4. *Uranium-molybdenum ore in paleovolcanoes and related minor intrusions.* Deposits are in fold-belts of Paleozoic rocks, along faults and folds at intrusive contacts in association with altered sandstone and pyroclasic rocks.

Type 5. *Apatite-uranium deposits in paleovolcanoes and carbonate-marine sediments.* Ore occurs in carbonate rocks interbedded with shales and sandstones; ore controlled by faulting and volcanogenic rock sequence.

Class II. *Hydrothermal deposits associated with rhyolite-granitic rocks.* Ore is concentrated in volcanogenic depressions and related fault zones; ore formed during post-volcanic hydrothermal activity.

Type 6. *Uranium deposits in volcanic depressions.* Ore is of late Paleozoic age, occurring in rhyolite tuffs and breccias associated with caldera tectonics.

Type 7. *Molybdenum-uranium deposits in subvolcanic intrusives.* Ore occurs along contact zones of highly fractured and faulted Paleozoic granite and quartz porphyries and intruded andesite.

Type 8. *Molybdenum-uranium deposits in volcanic pipes and plugs.* Ore occurs in stockworks and veins in breccia and mylonite zones resulting from volcanic intrusion and accompanying subsidence of Paleozoic basement rocks.

SERIES C. *Endogenic uranium deposits of reactivated regions.* Hydrothermal uranium deposits occur in trachyte-syenite and andesite-rhyolite rocks along reactivated tectonic zones.

Class III. *Hydrothermal deposits associated with trachyte-syenite rock formations.* Important hydrothermal uranium deposits occur in sodium-rich intrusives, with thorium in subvolcanic massifs, and titanium in crystalline basement rocks.

Type 9. *Thorium-uranium deposits in subvolcanic massifs.* Ore is associated with sodium-rich deep-seated intrusives cutting basement rocks; ore occurs in fracture and breccia zones along major faults.

(continued)

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HISTORICAL MARKET DATA

HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	—	—	—	—	—	—	—	6.35	6.35	6.40	6.45	6.50
1969	—	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	32.50	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00
1981	25.00	25.00	25.00	25.00	25.00	24.25	23.50	23.50	23.50	23.50	23.50	23.50
1982	23.00	23.00	22.50	20.75	20.50	19.25	18.25	17.00	17.00	17.50	19.75	20.25
1983	21.50	21.75	22.25	23.25	23.50	23.50	24.00	24.00	24.00	23.50	22.50	22.00
1984	20.50	17.50	17.00	17.75	17.75	17.50	17.50	17.50	17.50	16.00	15.50	15.25
1985	**15.00**											

HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	—	—	—	—	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38.40	37.90	37.60	37.30	31.60	30.60	29.00	28.70	27.70
1981	27.20	27.20	27.00	25.70	25.70	24.50	24.40	24.30	23.90	24.10	24.10	24.00
1982	24.00	23.70	23.40	22.60	22.70	21.50	20.30	19.10	17.30	17.00	17.55	18.80
1983	19.35	20.00	21.35	21.40	22.35	22.45	23.50	23.60	23.65	23.65	23.85	23.85
1984	23.05	22.50	19.25	17.90	17.00	16.50	16.60	16.40	16.55	16.05	15.90	15.90
1985	**16.20**											

HISTORICAL CONVERSION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U as UF_6)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	1.20	1.20	1.20	1.40	1.15	1.15	1.15	1.10	1.10	1.10	1.20	1.20
1982	1.20	1.20	1.20	1.20	1.00	1.00	1.00	0.90	1.10	1.60	1.45	1.45
1983	1.20	1.40	1.40	1.20	1.20	1.20	1.10	1.10	1.00	0.60	0.60	0.60
1984	0.60	0.30	0.80	0.80	0.80	0.00	0.00	0.80	1.00	1.00	0.80	0.80
1985	**1.00**											

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GOVERNMENT STATISTICS

AUSTRALIA

	Price Index of Materials Used in Manufacturing Industry—All Groups[1] (1969=100)	Award Rates of Pay Indexes Australia—Adult Males In Mining Wage and Salary Earners, Weekly Rates[2] (1976=100)
1983 Avg.	401.2	181.8
Oct 1983	397.5	188.3
Nov 1983	395.5	188.3
Dec 1983	399.2	188.1
Jan 1984	399.2	188.6
Feb 1984	402.5	188.5
Mar 1984	403.9	188.3
Apr 1984	404.2	196.2
May 1984	403.8	197.0R
Jun 1984	404.9	197.0R
Jul 1984	408.5	197.0R
Aug 1984	413.3	197.0R
Sep 1984	412.1	197.0R
Oct 1984	408.6R	197.0
Nov 1984	407.2	197.0

P = Preliminary R = Revised since last month

CANADA

	Industry Selling Price Index: Manufacturing[1] (1971=100)	Wage-earner Data: Average Hourly Earnings (C$)[2]					
		Uranium Mines (SIC 057)	Metal Mines* (SIC 051-059)	Mines, Quarries and Oil Wells[3] (SIC 051-099)	Primary Metal Industries Non-ferrous[4]		Chemicals and Chemical Products[5] (SIC 372-379)
					(SIC 296)	(SIC 298)	
1983 Avg.	298.8	—	—**	14.30	—	—	11.17
Dec 1983	302.9	17.84	15.11	14.66	11.86	10.60	11.51
Jan 1984	305.4	17.74	15.27	14.74	11.91	10.84	11.69
Feb 1984	306.6	17.78	15.59	14.90	12.04	10.82	11.51
Mar 1984	308.7	18.05	15.52	14.82	12.14	10.84	11.58
Apr 1984	310.5	18.06	15.83	15.10	11.96	10.34	11.63
May 1984	310.6	18.48	15.64	15.06	12.11	10.16	11.65
Jun 1984	311.0	18.08	15.48	14.80	12.38	10.40	11.66
Jul 1984	312.7R	17.81	15.72	14.92	12.53	10.18	11.82
Aug 1984	312.4R	17.24	15.36	14.92	12.44	10.34	11.78
Sep 1984	312.0	17.68	15.96	15.34	12.51	10.52	11.90
Oct 1984	312.3	17.64	16.15R	15.26R	12.69R	10.56R	11.96R
Nov 1984	313.5	18.08P	16.10P	15.35P	12.47P	10.53P	11.99P
Dec 1984	313.9	—	—	—	—	—	—

P = Preliminary R = Revised since last month

For annual averages prior to 1983, and for notes pertaining to these statistics, see pages 23-26 of Report 190 of June 1984.

*The 1980 average for Metal Mines was incorrectly reported as 10.59. The correct average is 10.58 (see Report 190).

**Two different methods were used in the 1983 "Metal Mines" category in reporting survey data, and Statistics Canada did not publish a 1983 average. The March 1983 figure for the old method was 14.73 and for the new method was 14.84. The published average for 1983 in Report 190 was a Nuexco calculation based on the available monthly statistics for 1983 with the exception of the March figure, where only the 14.84 value was taken into account.

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GOVERNMENT STATISTICS

REPUBLIC OF SOUTH AFRICA

	Average Declared Working Costs per per Metric Ton of Gold Ore Milled (Rand)[1]	Tonnage-Weighted Index of Average Working Costs per Metric Ton of Gold Ore Milled (March 1982=100)[2]	Consumer Price Index[3] (1975=100)[4]	Producer Price Index All Groups[5] (1975=100)	Total Employment in Mining and Quarrying (Code 35)[6]	Total Salaries and Wages in Mining and Quarrying (1,000 Rand) (Code 40)[6]
1983 Avg.	51.87	115.0	262.2	274.8	696,579	3,644,772
Nov 1983	—	—	271.4	281.6	688,459	317,485
Dec 1983	53.70	119.6	273.2	283.7	690,750	333,595
Jan 1984	—	—	274.7	283.3	689,807	326,619
Feb 1984	—	—	278.4	286.5	702,553	335,906
Mar 1984	55.30	123.1	281.9	288.0	715,628	342,332
Apr 1984	—	—	286.1	290.2	712,963	327,550
May 1984	—	—	288.3	292.6	710,040	327,937
Jun 1984	56.95	126.2	291.2	295.3	717,009	347,121
Jul 1984	—	—	295.1	296.0	717,121	369,964
Aug 1984	—	—	297.0	300.8	721,905	361,357
Sep 1984	60.64	133.2	299.9	304.1	721,470R	359,218
Oct 1984	—	—	303.7	308.7	717,865	363,755
Nov 1984	—	—	307.4	312.8	—	—
Dec 1984	—	—	309.4	—	—	—

UNITED STATES

	Producer Price Index[1]		Consumer Price Index[2]	GNP Implicit Price Deflator[3]	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[4]			
	Industrial Commodities (1967=100)	All Commodities (1967=100)	(1967=100)	(1972=100)	Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)	Electric and Electronic Equipment (SIC 36)
1983 Avg.	315.8	303.1	298.4	215.63	12.57	13.43	10.59	8.65
Nov 1983	318.3	305.5	303.1	—	12.64	13.56	10.86	8.77
Dec 1983	318.4	306.1	303.5	218.53	12.75	13.33	10.90	8.84
Jan 1984	319.1	308.0	305.2	—	12.67	13.38	10.91	8.88
Feb 1984	320.6	308.9	306.6	—	12.81	13.34	10.90	8.86
Mar 1984	321.9	311.0	307.3	220.58	12.85	13.33	10.95	8.88
Apr 1984	322.5	311.4	308.8	—	12.91	13.30	10.97	8.89
May 1984	323.3	311.7	309.7	—	12.99	13.37	11.02	8.89
Jun 1984	323.9	311.4	310.7	222.40	12.96	13.40	11.03	8.91
Jul 1984	324.0	312.0	311.7	—	13.02	13.36	11.12	8.95
Aug 1984	323.5	310.9	313.0	—	13.10	13.51	11.13	9.00
Sep 1984	322.3	309.5	314.5	224.36	13.20	13.39	11.23	9.08
Oct 1984	323.2	309.4	315.3	—	13.23R	13.53	11.32R	9.09R
Nov 1984	323.8	310.4	315.3	—	13.23	13.76	11.35R	9.15R
Dec 1984	323.0	309.9	315.5	225.90	13.21P	13.65P	11.35	9.26
Jan 1985	—	—	—	—	—	—	11.37P	9.33P

P = Preliminary   R = Revised since last month

For annual averages prior to 1983, and for notes pertaining to these statistics, see pages 23-26 of Report 190 of June 1984.

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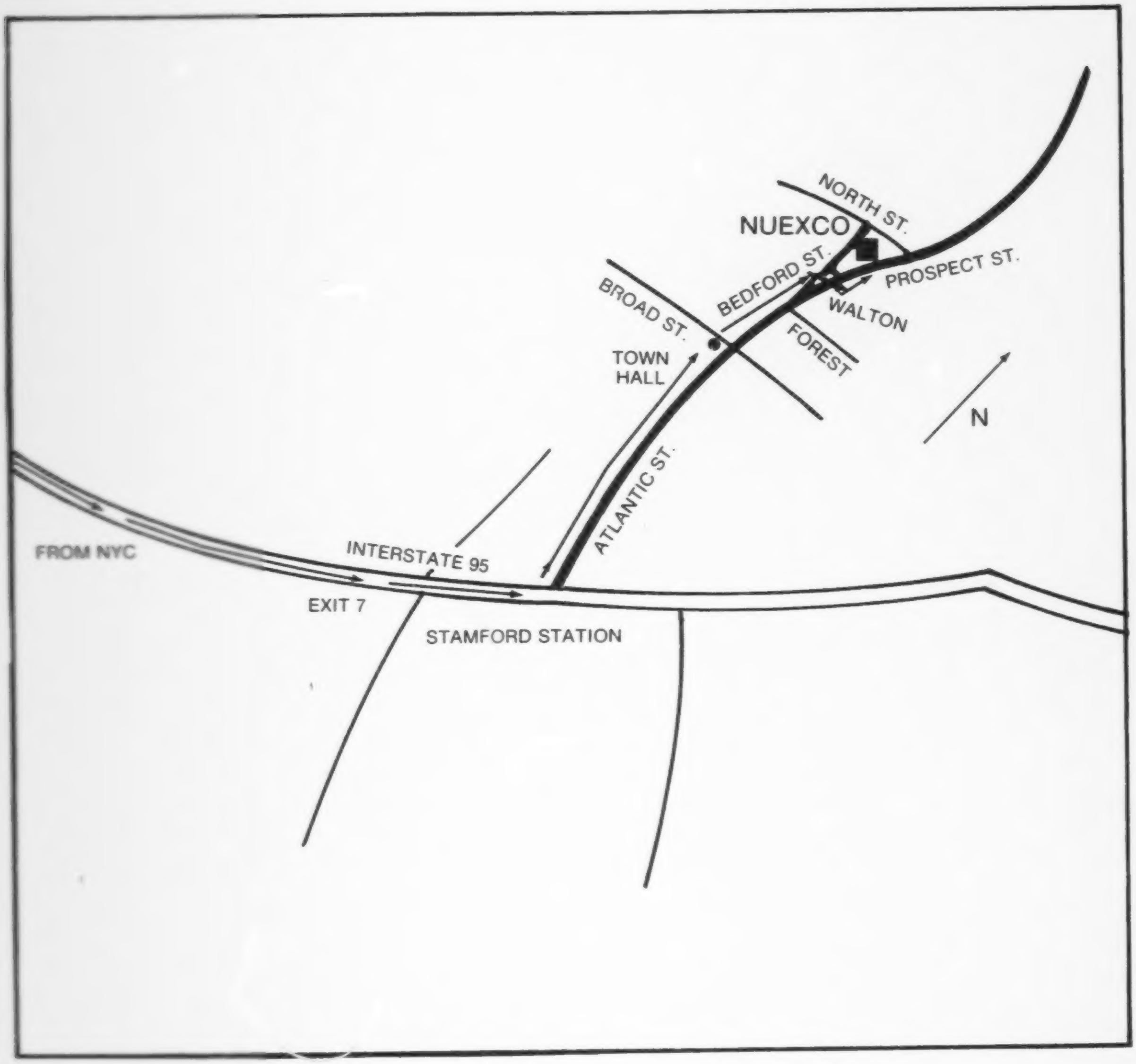
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WALTON
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N
ATLANTIC ST.
FROM NYC
INTERSTATE 95
EXIT 7
STAMFORD STATION

DIRECTIONS TO NUEXCO'S STAMFORD OFFICES

From New York City, take Interstate 95 North (Connecticut Turnpike).

Take Atlantic Street exit (Exit 8).

Left onto Atlantic Street. Follow for approximately 1/2 mile.
Atlantic will turn into Bedford Street at the Stamford Town Center.
Keep following Bedford Street through two stoplights.
After the second light, take a right onto Walton Place.
At stop sign, take a left onto Prospect Street. Our parking lot (underground) is located at 100 Prospect Street.

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NUEXCO

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NUEXCO

EXECUTIVE SUMMARY
REPORT 198
(All data as of January 31, 1985)

Exchange Value $15.00, down $0.25	The **Exchange Value** is **$15.00** per pound U_3O_8, down $0.25 since last month. One recent natural uranium sale is reported, involving approximately 100 to 300 thousand pounds U_3O_8 equivalent. It involved delivery prior to 1986, and also met the conditions for inclusion in the Transaction Value.
Supply-Demand Ratio rose to 3.3:1	Active spot and near-term **uranium supply** amounts to **4.2 million** pounds U_3O_8 equivalent, up 540 thousand pounds since last month. Active spot and near-term **uranium demand** totals **1.3 million** pounds, up 15 thousand pounds. The spot and near-term **supply-demand ratio** increased to **3.3:1.**
Transaction Value rose to $16.20	The **Transaction Value** is **$16.20** per pound U_3O_8, up $0.30 since last month. The calculation includes 14 transactions involving a total of 2.1 million pounds U_3O_8 and equivalent UF_6, and covers a period of 7 months.
Loan Use Charge Rate unchanged at 6%	The **Loan Use Charge Rate** remains **6 percent** per annum in a dormant market.
Conversion Value rose to $1.00	The **Conversion Value** is **$1.00** per pound U as UF_6, up $0.20 since last month. One secondary market conversion transaction is reported, involving approximately 500,000 pounds U as UF_6. Active secondary market demand for conversion services for delivery within three years totals 760 thousand pounds U as UF_6. No active supply is reported.
SWU Values: $112 for DOE-origin (FY85) $15 discount for FY86 $80 for non-DOE origin (calendar year 1985) $90 for calendar year 1986	The **SWU Values** for DOE origin at .3 tails and certifiable as excess, are **$112** per SWU for FY85 delivery, and **$15** per SWU discount from DOE base price for FY86 delivery, both unchanged from last month. SWU Values for other SWUs (non-DOE or non-certifiable) are **$80** per SWU for calendar year 1985 delivery, and **$90** per SWU for calendar year 1986 delivery. One secondary market SWU transaction is reported, involving less than 50 thousand SWUs. In addition, one low-enriched uranium sale is reported.
Basic Considerations	Allied Corporation and Sequoyah Fuels provide primary UF_6 conversion services in the USA and supply about forty percent of UF_6 conversion for reactors worldwide.
Australia	ERA's two recently announced long-term supply contracts with US utilities probably are structured as call options, the primary effect of which will be to diminish the market available to promoters of the Olympic Dam project.
South Africa	Fourth quarter Chamber of Mines uranium production was the lowest in 1984; total production in 1984 declined, but the depreciation of the rand contributed to another prosperous year for gold/uranium producers.
United States	DOE announced an offer from TVA for low-cost electricity for its enrichment plants, but the actual savings will amount to less than one dollar per SWU.
Raw Materials	Uranium exploration and mining activities in the USA declined steadily in 1984. Many operations shut down as production dropped more than 25 percent.

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NUEXCO REPORT 198 FIGURES OF THE MONTH (January 31, 1985)	This Month (Report 198)	Last Month (Report 197)	12 Months Ago (Report 186)
Exchange Value[1]	15.00	15.25	20.50
Transaction Value[1]	16.20	15.90	23.05
Loan Use Charge Rate[2]	6%	6%	6%
Conversion Value[3]	1.00	0.80	0.60
Near-Term Uranium Supply[4]	4.2	3.6	4.2
Near-Term Uranium Demand[5]	1.3	1.3	0.5
Near-Term Supply-Demand Ratio	3.3	2.9	8.3
Recent Uranium Sales:			
Number of Transactions[6]	1	7	5
Quantity of Material[7]	0.1–0.3	2.6	5.1–10.0
Nuexco SWU Values:[8]			
DOE origin, certifiable as excess, 0.3 tails assay			
FY85 delivery	112	112	—
FY86 delivery	15[9]	15[9]	—
Other SWUs (non-DOE or non-certifiable)			
1985 delivery	80	80	—
1986 delivery	90	90	—
USDOE SWU Prices:			
USEC	135.00	135.00	135.00
AFC	153.00[10]	153.00[10]	138.65
Requirements	157.00[10]	157.00[10]	149.85
Market Value of Enriched UF_6[11] [12]:			
2.5 w/o U_{235}	506	507	586
3.0 w/o U_{235}	656	657	753
3.5 w/o U_{235}	808	810	923
4.0 w/o U_{235}	964	965	1,095

---

[1] US $ per pound U_3O_8 equivalent.

[2] Per annum.

[3] US $ per pound U as UF_6.

[4] Active inquiries to sell, for delivery within 12 months after contract signing (millions of pounds U_3O_8).

[5] Active inquiries to purchase, for delivery within 12 months after contract signing (millions of pounds U_3O_8).

[6] Uranium sales only; does not include loans, conversion, or SWU transactions.

[7] Millions of pounds U_3O_8, equivalent.

[8] US $ per SWU.

[9] Discount from USEC base price on delivery.

[10] Effective 10/1/84.

[11] Calculated using the Nuexco Exchange Value, Conversion Value, and 0.30 percent tails assay. From 10/31/83 through 2/29/84, calculations used the Nuexco SWU Value for DOE origin and FY84 delivery. As of 3/31/84, calculations use the Nuexco SWU Value for DOE origin and FY85 delivery.

[12] US $ per KgU as UF_6, rounded to the nearest $.

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MARCH 1985 NUMBER 199

MONTHLY REPORT

ON THE NUCLEAR FUEL MARKET

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MONTHLY REPORT ON THE NUCLEAR FUEL MARKET

March 1985 No. 199

R. WESLEY MILLER, *EDITOR* CLARK M. BEYER, *ASSOCIATE EDITOR*

PRICING

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To Our Readers

We are pleased to announce the election of **James E. Vaughan** as President of Nuexco and **M. J. Reaves** as Senior Vice President.

* * *

T. A. (Tom) Boyden retired from Nuexco on February 28, 1985. Tom spent eleven years with Nuexco evaluating the feasibility and marketing strategies of uranium mining projects worldwide. During this period, Tom visited most of the world's important uranium districts, and shared his insight with Nuexco subscribers in the Raw Materials articles published in the Monthly Report.

Tom plans to continue his participation in the uranium industry as an independent consultant. He has formed TABCO, a company which will specialize in project identification and evaluation, ore reserve assessment, recovery technique, and marketing strategies. We wish him the best of luck.

Tom's new business address:

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* * *

Included with this Report is a map to our Atlanta offices. We welcome customer visits.

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NATURAL URANIUM AND SECONDARY MARKET CONVERSION

The **Exchange Value** as of February 28, 1985 is **$15.00** per pound U_3O_8, unchanged since last month. **Active supply** of natural uranium (U_3O_8 and UF_6) for spot or near-term delivery totals **5,315,000** pounds U_3O_8 or equivalent UF_6, up 1,135,000 pounds since last month. The corresponding figure for **active demand** is **2,270,000** pounds, up 1,005,000 pounds. The spot and near-term **supply-demand ratio** fell to **2.3:1.**

The *Current Market Data* section of this Report lists nine natural uranium sales transactions, involving a total of approximately 2,100,000 pounds equivalent U_3O_8. Five of the transactions reported this month involved natural UF_6, eight involved deliveries before 1986, and six met the criteria for inclusion in the current Transaction Value calculation. In addition, two low-enriched uranium transactions are reported.

The **Transaction Value** as of February 28, 1985 is **$15.70** per pound U_3O_8, down $0.50 since last month. The current Transaction Value includes 13 transactions involving a total of 2.3 million pounds U_3O_8 or equivalent UF_6 and covers a period of 4 months. The Transaction Value fell as a result of the removal from the calculation of four months' transactions involving some one million pounds of uranium. Those transactions, most of which took place in the summer of 1984, involved higher prices consistent with the significantly higher Exchange Value ($17.50) in those months.

The **Loan Use Charge Rate** as of February 28, 1985 declined to **5 percent** per annum as a lender offered a substantial quantity of material at that rate.

* * *

The Exchange Value remained at $15.00 in a market characterized by a widening range of prices at which transactions take place. Some evidence suggested a price firming, yet several buyers still found material available at prices below $15.00. Other transactions were concluded at or well above $15.00. Continued seller resistance to substantially lowering prices, combined with a growing feeling among discretionary buyers that market prices had temporarily stabilized, led to increased buying activity and an active month for transactions, including nine sales of natural uranium. Although substantial quantities of natural uranium remain available, downward pressure on prices appears to have subsided, at least temporarily.

* * *

The **Conversion Value** is **$1.00** per pound U in UF_6, unchanged since last month. Two secondary market conversion transactions are reported, involving approximately 200,000 pounds U in UF_6. Active supply of secondary market conversion services for delivery within three years totals 300,000 pounds U as UF_6. Active secondary market demand for conversion amounts to 255,000 pounds U in UF_6.

ENRICHED URANIUM AND SWUS

The Nuexco **SWU Values** as of February 28, 1985 are:

1. For **DOE origin,** a tails assay of 0.30 weight-percent U_{235}, and certifiable as excess:
   a. For FY85 delivery, **$102** per SWU, down 10;
   b. For FY86 delivery, **$20** discount from the USEC base price on delivery (15 last month);
2. For **other** SWUs (includes DOE origin SWUs not certifiable as excess and non-DOE origin SWUs):
   a. For delivery in calendar year 1985, **$80** per SWU, unchanged;
   b. For delivery in calendar year 1986, **$88** per SWU, down 2.

One secondary market SWU transaction is reported, involving less than 50,000 SWUs.

* * *

The decline in price for DOE-origin, certifiable as excess SWUs for delivery in fiscal year 1985 reflects the minimal demand for FY85 material. Almost all supply has been depleted, and substantial discounts can be found. Nevertheless, the market remains open until DOE announces new FY86 prices, expected this month. Some sellers with FY85 and FY86 SWUs are concentrating their sales efforts on the FY86 market, where known demand exists. Sellers realize that they should sell quickly, since prices are likely to drop soon after DOE announces new prices, especially in light of DOE's announced intentions relative to incentive pricing. With several sellers competing actively, discounts for FY86 SWUs have increased slightly.

The market for other SWUs (non-DOE or DOE SWUs not certifiable as excess), while relatively dormant, has loosened slightly. Prices are dropping slowly as non-DOE suppliers try to match DOE incentive pricing. This applies to SWUs purchased for delivery in 1987 and beyond.

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Nuexco's information indicates that the DOE incentive pricing initiative, although not public at press time, will be made available to all USEC customers with uncommitted requirements, including those customers that will reduce their 100-percent-of-requirements commitment to a 70-percent commitment as allowed under the USEC. DOE will send the offer to its customers in March, and customers will be required to respond within 45 days. It appears that FY87 and FY88 SWUs will be priced at $90 per SWU, while FY89 and FY90 SWUs will be priced at $90 per SWU, escalated. The escalated price for FY89 and FY90 material will follow the USEC escalation formula for FY87 SWUs. Utilities will be able to purchase incentive-priced SWU for the first two years, the first three years or all four years. The commitment must be made to DOE within the 45-day response period.

The DOE program depends on the acceptance of a certain percentage of customers, which is as yet unspecified. The effect of other terms contained in the USEC, such as the Variable Tails Assay Option (VTAO), will be determined depending on the response to the incentive plan. As in the case of the USEC itself, market reaction to DOE's sales efforts can still have an effect on the specific terms and conditions which will be made available to its customers.

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CURRENT MARKET DATA

February 28, 1985	Market Values	Active Supply[1] (thousands)	Active Demand[1] (thousands)
EXCHANGE VALUE	**$15.00**/lb. U_3O_8	5,315	2,270
CONVERSION VALUE	**$1.00**/lb. U in UF_6	300	255
SWU VALUES			
DOE origin, certifiable as excess, 0.3 tails assay			
FY85 delivery	**$102**/SWU		
FY86 delivery	**$20** discount/SWU		
Other SWUs (non-DOE or non-certifiable)			
calendar year 1985 delivery	**$80**/SWU		
calendar year 1986 delivery	**$88**/SWU		
LOAN USE CHARGE RATE	5%/annum	0	0

TRANSACTION VALUE	$/lb. U_3O_8	Millions of Pounds	Number of Transactions	Number of Months
	15.70	2.3	13	4

[1] Supply and demand tables in the *Current Market Data* section of this Report detail the numbers for each category.

DEFINITIONS

1. The **Exchange Value** is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the date indicated.
2. The **Conversion Value** is Nuexco's judgment of the price at which spot and near-term transactions for significant quantities of conversion services could be concluded in the secondary market as of the date indicated.
3. The **SWU Values** represent Nuexco's judgment of the price at which transactions for the sale of significant quantities of SWUs of stated origin for delivery in the specified time period could be concluded as of the date indicated.
4. The **Loan Use Charge Rate** is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the date indicated.
5. The **Transaction Value** is a weighted average price of recent natural uranium sales transactions. The calculation is based on prices paid in:
   a. Transactions closed within the previous three-month period for which delivery is scheduled within one year of the transaction date;
   b. At least ten transactions;
   c. Transactions involving a sum total of at least 2 million pounds U_3O_8 equivalent.

   The sample time is extended as necessary to include these minima. Other currencies are converted to US dollars using conversion rates in effect on or near the transaction date.

DERIVATIONS AND COMMENTS

1. All Market Values are based on:
   a. Data from recently completed transactions.
   b. Data from pending transactions.
   c. Firm bids to buy or borrow, and firm offers to sell or lend.
   d. Prices purchasers or rates borrowers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy or borrow, and prices sellers or rates lenders have expressed a willingness to offer, but for which Nuexco is not aware of firm offers to sell or lend.
2. Prices associated with deliveries under old or renegotiated contracts or other than arm's-length transactions are not considered in the determination of these Market Values.
3. In the determination of the Conversion Value, Nuexco does not consider transportation charges other than those customarily provided by primary suppliers of conversion services.
4. The prices of conversion services or SWUs delivered under long-term contracts with primary suppliers are not considered in the determination of either the Conversion Value or SWU Value.
5. For the DOE SWU Values, Nuexco converts SWU prices at varying tails and product assays to equivalent SWU prices at a tails assay of 0.30 weight-percent U_{235} and a product assay of 3.0 weight-percent U_{235}, assuming feed costs corresponding to the Nuexco Exchange and Conversion Values determined as of the same date.
6. In calculating the Transaction Value, Nuexco does not account for the price of uranium delivered in connection with contracts which call for "market price" mechanisms. This exclusion applies particularly to contracts in which delivery prices are expressed as a function of future Exchange Values or any other indeterminant variable. Also excluded from the calculation are any other transactions in which the delivery price is defined in such a way that it cannot currently be determined.

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CURRENT MARKET DATA

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

	per lb. U_3O_8 in Concentrates			per kg. U in Concentrates		
Country (currency)	This Month (Feb. 28, 1985)	Last Month (Jan. 31, 1985)	12 Months Ago (Feb. 29, 1984)	This Month (Feb. 28, 1985)	Last Month (Jan. 31, 1985)	12 Months Ago (Feb. 29, 1984)
Australia (dollar)	20.76	18.38	18.54	53.97	47.78	48.20
Belgium (comm. franc)	1,001	949.37	933	2,602	2,468	2,426
Canada (dollar)	20.73	19.91	21.89	53.89	51.77	56.91
Finland (markka)	103.38	99.40	98.65	268.76	258.43	256.46
France (franc)	152.39	145.07	140.00	396.19	377.14	363.97
FRG (mark)	49.85	47.53	45.50	129.60	123.56	118.29
Italy (lira)	30,902	29,240	28,262	80,339	76,017	73,476
Japan (yen)	3,881	3,817	4,084	10,090	9,923	10.618
Netherlands (guilder)	56.24	53.74	51.33	146.22	139.72	133.46
South Africa (rand)	30.00	29.56	21.02	77.99	76.84	54.65
Spain (peseta)	2,745	2,628	2,611	7,137	6,832	6,788
Sweden (krona)	140.71	135.62	135.98	365.82	352.59	353.50
Switzerland (franc)	42.37	40.11	37.82	110.16	104.27	98.33
UK (pound)	13.76	13.27	11.71	35.78	34.50	30.44
US (dollar)	15.00	15.00	17.50	39.00	39.00	45.50

TRANSACTION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

	per lb. U_3O_8 in Concentrates			per kg. U in Concentrates		
Country (currency)	This Month (Feb. 28, 1985)	Last Month (Jan. 31, 1985)	12 Months Ago (Feb. 29, 1984)	This Month (Feb. 28, 1985)	Last Month (Jan. 31, 1985)	12 Months Ago (Feb. 29, 1984)
Australia (dollar)	21.73	19.85	23.84	56.49	51.60	61.97
Belgium (comm. franc)	1,047	1,025	1,200	2,723	2,666	3,120
Canada (dollar)	21.70	21.51	28.15	56.41	55.91	73.17
Finland (markka)	108.20	107.36	126.83	281.30	279.10	329.73
France (franc)	159.50	156.67	180.00	414.68	407.31	467.96
FRG (mark)	52.18	51.33	58.50	135.65	133.45	152.09
Italy (lira)	32,344	31,579	36,337	84,088	82,098	94,469
Japan (yen)	4,062	4,122	5,251	10,561	10,717	13,651
Netherlands (guilder)	58.87	58.04	66.00	153.04	150.90	171.59
South Africa (rand)	31.40	31.92	27.03	81.63	82.99	70.26
Spain (peseta)	2,873	2,838	3,357	7,470	7,378	8,728
Sweden (krona)	147.28	146.47	174.83	382.89	380.80	454.51
Switzerland (franc)	44.35	43.32	48.63	115.30	112.61	126.42
UK (pound)	14.40	14.33	15.06	37.45	37.25	39.14
US (dollar)	15.70	16.20	22.50	40.82	42.12	58.50

[1] Calculated using currency exchange rates published in the *Wall Street Journal* on February 28, 1985.

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CONVERSION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb. U as UF_6			per kg. U as UF_6		
	This Month (Feb. 28, 1985)	Last Month (Jan. 31, 1985)	12 Months Ago (Feb. 29, 1984)	This Month (Feb. 28, 1985)	Last Month (Jan. 31, 1985)	12 Months Ago (Feb. 29, 1984)
Australia (dollar)	1.38	1.23	0.32	3.05	2.70	0.70
Belgium (comm. franc)	66.71	63.29	16.00	147.07	139.53	35.27
Canada (dollar)	1.38	1.33	0.38	3.05	2.93	0.83
Finland (markka)	6.89	6.63	1.69	15.19	14.61	3.73
France (franc)	10.16	9.67	2.40	22.40	21.32	5.29
FRG (mark)	3.32	3.17	0.78	7.33	6.99	1.72
Italy (lira)	2,060	1,949	484.50	4,542	4,298	1,068
Japan (yen)	258.73	254.45	70.01	570.41	560.97	154.35
Netherlands (guilder)	3.75	3.58	0.88	8.27	7.90	1.94
South Africa (rand)	2.00	1.97	0.36	4.41	4.34	0.79
Spain (peseta)	183.02	175.19	44.76	403.48	386.23	98.69
Sweden (krona)	9.38	9.04	2.33	20.68	19.93	5.14
Switzerland (franc)	2.82	2.67	0.65	6.23	5.89	1.43
UK (pound)	0.92	0.88	0.20	2.02	1.95	0.44
US (dollar)	1.00	1.00	0.30	2.20	2.20	0.66

SWU VALUES EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	DOE SWU FY85 (February 28, 1985)	Non-DOE SWU 1985 delivery (February 28, 1985)	Non-DOE SWU 1986 delivery (February 28, 1985)
Australia (dollar)	141.18	110.73	121.80
Belgium (comm. franc)	6,805	5,337	5,871
Canada (dollar)	140.96	110.56	121.61
Finland (markka)	702.96	551.34	606.48
France (franc)	1,036	812.76	894.04
FRG (mark)	338.98	265.87	292.46
Italy (lira)	210,136	164,813	181,294
Japan (yen)	26,391	20,699	22,768
Netherlands (guilder)	382.45	299.96	329.96
South Africa (rand)	204.00	160.00	176.00
Spain (peseta)	18,668	14,641	16,105
Sweden (krona)	956.85	750.47	825.52
Switzerland (franc)	288.14	225.99	248.59
UK (pound)	93.58	73.39	80.73
US (dollar)	102.00	80.00	88.00

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[1] Calculated using currency exchange rates published in the *Wall Street Journal* on February 28, 1985.

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CURRENT MARKET DATA

RECENT TRANSACTIONS[1]

Uranium Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U_3O_8 equivalent)	Approximate Price as Percent of Current E.V.	Seller	Buyer	Remarks
3335	1985	101-300	117	Canadian Producer	R[2]	UF_6.
3334	1985	101-300	R[2]	Trader	Trader	UF_6.
3333	1985	less than 50	96	US Producer	US Utility	
3331	1985	50-100	100	European Utility	R[2]	UF_6.
3330A	R[2]	less than 50	101	European Utility	R[2]	Contained in LEU.
3322A	1985	less than 50	105	Trader	European Utility	Contained in LEU.
3321	1985	50-100	less than 97	R[2]	European Utility	UF_6.
3320	1985	301-600	100	Trader	European Utility	UF_6.
3319	1985	101-300	105	US Producer	Far East Utility	
3318	1988-1992	601-1,000	see remarks	US Producer	US Utility	Occurred in late 1984. Price escalated from January 1985.
3306	1985	101-300	100	US Producer	Far East Utility	

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[1] Transactions listed are not limited to those in which Nuexco was involved, but also include others of which Nuexco is aware.

[2] The notation *R* means that Nuexco either does not know, or that Nuexco has restricted that information to protect client confidentiality.

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RECENT TRANSACTIONS[1] *(continued)*

Secondary Market Conversion Services

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U equivalent)	Approximate Price as Percent of Current C.V.	Seller	Buyer	Remarks
3340	1985	50-100	93	US Utility	US Utility	
3332	1985	101-300	100	US Utility	Trader	

Enrichment Services
Secondary Market Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity[2] (thousands of SWUs)	Approximate Price[3] as Percent of Current SWU Value[4]	Seller Group	Buyer Group	SWU Origin	Remarks
3339	1985	less than 50	110	US Utility	US Fabricator	DOE	Tails assay 0.2%.
3330B	R[5]	less than 50	R[5]	European Utility	R[5]	R[5]	Contained in LEU.
3322B	1985	less than 50	113	Trader	European Utility	DOE	Contained in LEU.

---

[1] Transactions listed are not limited to those in which Nuexco was involved, but also include others of which Nuexco is aware.

[2] If tails assay is unknown or unspecified, Nuexco's calculation of SWU quantity assumes 0.30 w/o tails assay.

[3] Price is not normalized to 0.30% tails assay.

[4] Refers to SWU Value that corresponds to SWUs included in transaction. When prices and SWU values are expressed as discounts (e.g., X dollars less than DOE's USEC base price at time of delivery), the percentage refers to the ratio of the *discounts*, not the ratio of the prices.

[5] The notation *R* means that Nuexco either does not know, or that Nuexco has restricted that information to protect client confidentiality.

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CURRENT MARKET DATA

URANIUM SUPPLY
(February 28, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Spot or Near-term[2]	Intermediate or Long-term	Remarks
Available for Sale:			
ACTIVE			
1575	500	500 per year	
1860	400	1,500 per year	
2038	1,000	1,000 per year	UF_6
2134	220	220 per year	1986-87
2288A	40	—	
2288B	295	—	UF_6
2389	200	—	
2392	35	—	UF_6
2499	15	—	
2538*	25	—	
2565	400	—	
2584	300	—	
2603	10	—	
2633*	1,800	—	
2650*	40	—	
2675*	35	—	UF_6
2263	—	500 per year	1985-90
2625*	—	250 per year	1987-89
2657	—	980	1986; UF_6
TOTAL:	5,315		
INACTIVE			
2191	125	—	UF_6
2275	150	—	
2335	275	—	
2336	250	250 per year	1985-94
2495	130	—	UF_6
2553	300	—	
2654*	250	250 per year	UF_6
0564	—	1,000 per year	1985-90
2271	—	500 per year	1985-88
2297	—	200 per year	1986-89
2368	—	250 per year	1987-90
2514	—	1,000 per year	
2574	—	500	UF_6
2670*	—	525	1987
TOTAL:	1,480		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2236, 2326, 2509, 2516, 2538A, 2569, 2664.

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URANIUM DEMAND
(February 28, 1985)

	Delivery Period[1] (Thousands of Pounds U_3O_8)		
Nuexco Project Number	**Spot or Near-term[2]**	**Intermediate or Long-term**	**Remarks**
Inquiries to Purchase:			
ACTIVE			
2419*	65	—	UF_6
2548	300	—	
2590*	225	—	U_3O_8 or UF_6
2636*	100	—	
2661*	260	260 per year	1986-87
2674*	1,000	—	
2676*	160	—	UF_6
2690	160	—	
2217	—	1,000 per year	1989-95
2442	—	4,000	1986-95
2507	—	600	1987-89
2540	—	400 per year	1989-94
2659*	—	320 per year	1988-91
TOTAL:	2,270		
INACTIVE			
2329	500	—	1985
2576	20	—	UF_6
1999	—	50 per year	1986-90
2244	—	350 per year	1987 on
2414	--	365	1987-88
2457B	—	650	1987
2586	—	300	1987
2643	—	150 per year	1987 on
TOTAL:	520		

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*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2457A, 2638.

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CURRENT MARKET DATA

LOAN SUPPLY AND DEMAND
(February 28, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Within 1 Year	Beyond 1 Year	Remarks
Available for Loan:			
INACTIVE			
1938	2,000	—	UF_6
2128	700	—	
2139	2,000	—	
2469A	800	—	
2483	550	—	
2667*	800	—	
TOTAL:	6,850		

No inquiries to borrow this month.

CONVERSION SUPPLY AND DEMAND
(February 28, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U as UF_6) Within 3 Years	Beyond 3 Years	Remarks
Available for Sale:			
ACTIVE			
2051*	300	—	
TOTAL:	300		
INACTIVE			
2438	500	250 per year	1986-87
2511	600	700	1986-90
TOTAL:	1,100		
Inquiries to Purchase:			
ACTIVE			
2419A*	55	—	
2602*	200	—	
TOTAL:	255		
INACTIVE			
2529*	225	—	
2587	285	—	
2644	—	475	1987 on
TOTAL:	510		

*New or revised since last month.

[1] Measured from the date of this Report.

Projects removed since last month: 2638A.

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SWU SUPPLY
(February 28, 1985)

	Delivery Period[1] (Thousands of SWUs)		
Nuexco Project Number	Spot or Near-term[2]	Intermediate or Long-term	Remarks
Available for Sale:			
ACTIVE			
2100	150	100 per year	
2583	50	—	
2624	100	—	
2631	150	—	
2633B	330	—	
2664*	150	—	
2285	—	300	
2359*	—	300	
2513	—	25	1986
2517	—	150	1986-89
2571	—	55	1987
2657A	—	175	1986
TOTAL:	930		
INACTIVE			
2164	25	—	
2689*	40	—	
2378	—	120	1988
2510	—	50	
2652*	—	25	1986
TOTAL:	65		

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*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes SWUs deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2531, 2589, 2632.

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CURRENT MARKET DATA

SWU DEMAND
(February 28, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of SWUs) Spot or Near-term[2]	Intermediate or Long-term	Remarks
Inquiries to Purchase:			
ACTIVE			
2655	10	—	
2665	50	—	
2669*	50	—	
2519	—	30 per year	1987 on
2578	—	100	1986
2653	—	100	1986-90
2658	—	5	1986
2693*	—	100	1989-90
TOTAL:	110		
INACTIVE			
2543	25	25	1986
2585*	90	—	1986
2500	—	500	1987-90
2512	—	15 per year	1987 on
2595	—	50	1986
TOTAL:	115		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes SWUs deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2459, 2480, 2640, 2689A.

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ASSESSMENT OF TODAY'S URANIUM MARKET: STARTING TO COME OF AGE

by
James E. Vaughan
President, Nuexco

The following is a slightly edited version of a speech presented by Nuexco President Jim Vaughan to the Atomic Industrial Forum's Fuel Cycle Conference in New Orleans, Louisiana, on March 12, 1985.

Market Overview

At first glance, the two big news items in the uranium market during the past year have been the USDOE's new contract, the Utility Services Enrichment Contract (USEC), and the definition of the Cigar Lake discovery in Saskatchewan. The USEC has been important news because it is a requirements-type contract which is replacing a fixed-commitment contract. Its near-term effect has been to weaken the uranium market because it has delayed the consumption of natural uranium (consumption for this purpose being defined as the introduction of uranium into the enrichment/fabrication "pipeline"). Eighteen months ago, Nuexco was forecasting substantial unfilled requirements beginning in the 1985-86 period. Now it appears that real unfulfilled requirements will not exceed ten million pounds U_3O_8 per year until 1988 (Figure 1).

The Cigar Lake deposit was the other big new items in 1984, although its only effect to date has been psychological. But markets react to psychological factors, and the announcement of such a huge deposit, estimated at 300 million pounds U_3O_8 at greater than ten-percent grade, has added to the already strong feeling that there is an ample supply of uranium in the world for many years to come. Moreover, the history of exploration suggests that Cigar Lake is probably not just one of a kind.

Later in this paper, other more subtle factors in the market will be discussed, in addition to these obvious points. In particular, we will examine the development of the spot market as it relates to the total market for uranium.

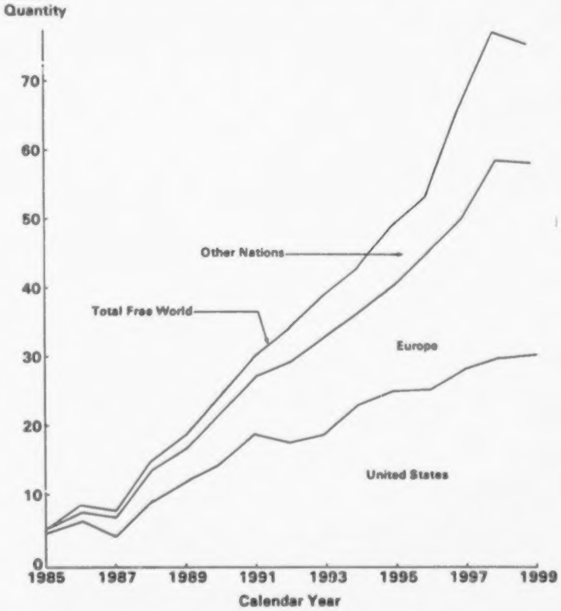

FIGURE 1
FREE WORLD UNFILLED REQUIREMENTS
(Millions of Pounds U308 per Year)

The Nuexco Exchange Value during 1984 dropped from US$20.50 in January to $15.25 in December, and it has dropped to $15.00 in 1985. In addition to Cigar Lake and the jolt of displaced consumption brought on by the USEC, the market continues to react to plant cancellations that have released or threaten to release large quantities of uranium into the spot and near-term markets. There have also been sales of marginal uranium production that are relatively price-insensitive. These factors were further exacerbated by the following influences:

1. The strong US dollar has had an effect on the market because uranium prices are normally quoted in US dollars in international transactions. The strong dollar in some cases has enabled non-US sellers to become more aggressive in pricing, since in recent months the US dollar has in general been rising faster than uranium prices have been falling.
2. World[1] uranium production has exceeded consumption by well over 25 million pounds U_3O_8 per year for the last five years. Production is expected to exceed consumption by nearly 20 million pounds in 1985.
3. In theory, world commercial inventories as of the end of 1984 are sufficient to meet all requirements through 1989 without any further production. That is, a five-year forward inventory now exists in the commercial uranium market. For comparison, world stocks of copper at present amount to only about three months' forward supply. The inventory situation is an important reason why movements in uranium prices, even spot prices, are relatively

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[1] World = WOCA (World Outside Centrally-planned economic Areas).

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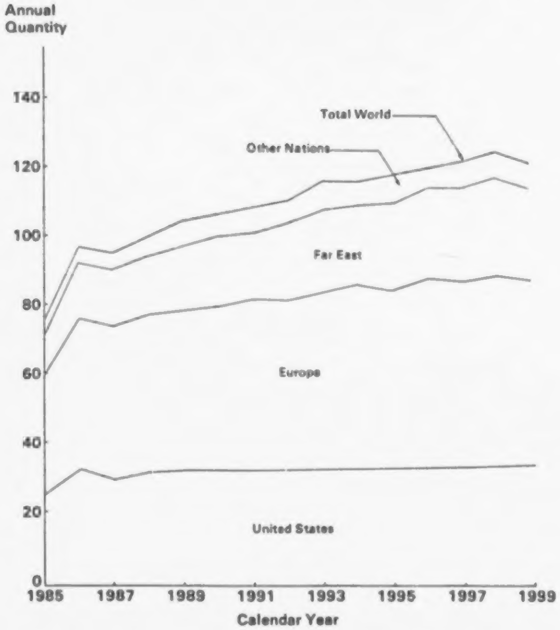
slow. Such price motion is dampened by the enormous inertia of the world stockpile. The outlook predicts a continued weak spot market for the next two or three years as real unfilled near-term requirements remain low, and secondary market activity is expected to remain high. The "secondary market" refers to new sales of uranium that previously has been sold; for example, the case of a utility selling off some of its inventory.

FIGURE 2
WORLD URANIUM CONSUMPTION
(Millions of Pounds U308 Equivalent)

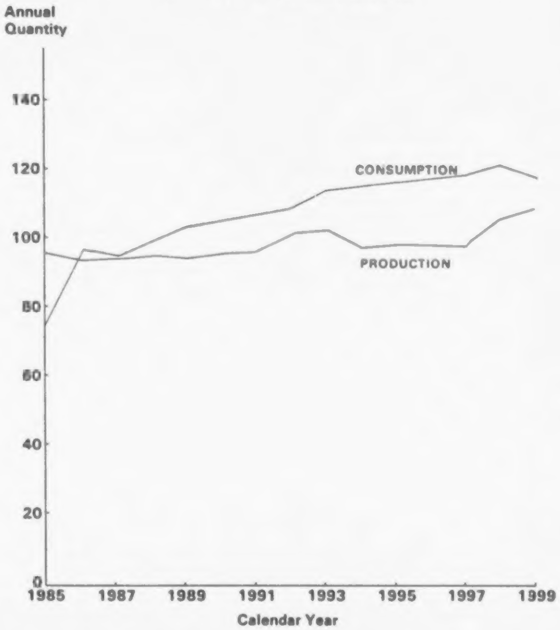


We do expect, however, that 1986 will bring the long-awaited crossover between consumption (Figure 2) and production (Figure 3). Nuexco forecasts 1986 world consumption at 97 million pounds U_3O_8, while production is expected to fall to 94 million pounds U_3O_8. Thus, beginning in 1986, we can expect to see the world inventory position gradually begin to decrease (Figure 4).

A Look at Pricing Concepts

Pricing trends are an aspect of the market that requires some examination of market data. Conventional belief has held that only a small fraction of uranium is traded at spot market prices; roughly five to ten percent is the amount often quoted. It is interesting to take a closer look at the market and the various types of transactions to see if this conventional idea is valid, and to forecast the direction that pricing concepts may be taking.

FIGURE 3
WORLD PRODUCTION COMPARED TO CONSUMPTION
(Millions of Pounds U308)



We arbitrarily decided to segregate the total 1984 uranium market deliveries into the following three pricing categories. The data includes sales of natural uranium concentrates (U_3O_8) and UF_6, as well as the natural uranium component in sales of enriched uranium:

1. Spot-related price;
2. Negotiated price;
3. Fixed price.

Contracts having spot-related prices include both simple spot contracts as well as longer-term contracts with pricing provisions directly related to the spot market (for example, by reference to the Nuexco Exchange Value). The negotiated price category includes long-term contracts containing provisions for the parties to meet periodically following contract signature to negotiate the price of a delivery or series of deliveries (for example, the great majority of deliveries to Japanese buyers). The fixed price category includes formula prices set forth in long-term contracts without any substantial reference in the formula to spot market indicators or negotiations. Cost-plus contracts and captive production are also included in this category.

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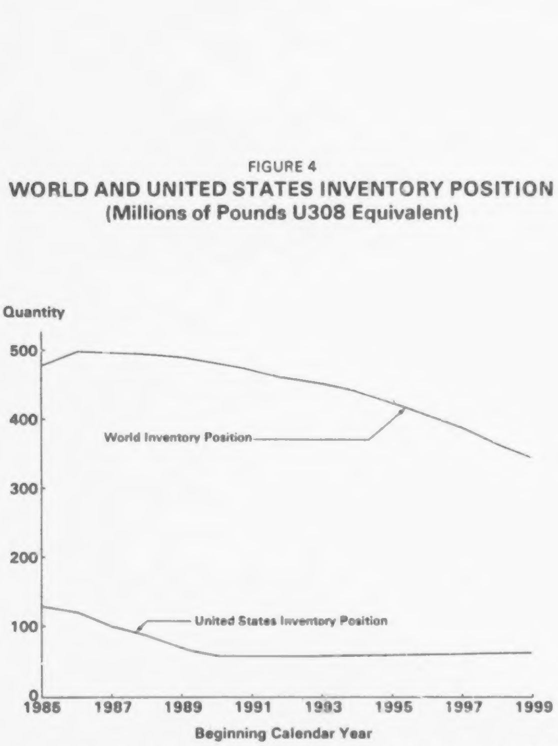
FIGURE 4

WORLD AND UNITED STATES INVENTORY POSITION
(Millions of Pounds U308 Equivalent)



In order to classify all 1984 deliveries into only three categories, some arbitrary decisions were necessary. Some contracts are easy to classify, such as simple spot sales or simple fixed long-term prices transactions, with or without formula escalation. Others are hybrids which include characteristics of more than one category. For example, some spot market price-related contracts contain floor price provisions. It was decided that in those cases where the floor price was substantially higher than the 1984 spot market price, the contract would be classified as fixed. If the floor price were of the order of the spot price level or lower, the contract would be classified as spot.

Table 1 contains a breakdown of the 1984 market resulting from this analysis. A total of 113 million pounds U_3O_8 equivalent was delivered in 1984 under 235 purchase-and-sale agreements. Of this amount, some 24 million pounds U_3O_8 (80 contracts) were delivered at spot market prices. A total of 26.5 million pounds U_3O_8 (33 contracts) was delivered under prices negotiated between the parties after the delivery contract was signed. The balance, 62 million pounds U_3O_8 (122 contracts), was delivered under formula prices, floor prices, or other arrangements not tied to a spot market indicator or annual negotiations. The percentages are as follows:

spot	21.1 percent
negotiated	23.5 percent
fixed	55.4 percent

The 1984 deliveries are further described in Table 2 by both production region and type of buyer. Total world estimated production in 1984 amounted to 99 million pounds U_3O_8. In a perfect market involving only producers, consumers and no intermediaries, and no secondary market or producer inventories, production would approximate deliveries. However, the uranium market is not perfect in that respect. Substantial secondary market activity has occurred in recent years, and producers add and subtract from inventory, including the practice of buying in the secondary market for redelivery. Thus, the additional deliveries in the latter group bring the 1984 total to 112.6 million pounds U_3O_8 equivalent, although most deliveries are in fact from producers to users.

The 24 million pounds traded at spot market prices in 1984 can be divided further as follows:

Transaction Type	**Million pounds U_3O_8**
1. Spot transactions	15.5
2. Longer term contracts having prices directly related to spot market indicators	8.3
TOTAL spot-related deliveries	23.8

A variation of the data in Table 1 is shown in Table 3. The objective of this variation is to determine the possible amount of material delivered at spot prices if the 1984 spot price level had been roughly double. This would neutralize the effect of most of the floor prices that placed many spot-related contracts in the "Fixed" category in Table 1. Under these different conditions, as indicated in Table 3, about 36 million pounds U_3O_8 would have been delivered at the spot price, an increase of 12 million pounds (50 percent). This 12 million pounds is the quantity of uranium now being delivered at fixed (floor) prices, material that would have been sold at spot prices had the spot market been considerably stronger.

In an effort to locate a trend, we performed a similar analysis to break down 1983 deliveries by pricing category. As indicated in Table 4, about 19.9 million pounds U_3O_8 equivalent (83 contracts) were delivered in 1983 at spot prices, or almost 20 percent of the total. With the results of this two-year analysis, plus the conventional belief that at one time only five to ten percent of uranium was traded at spot prices, one may infer a tendency toward the delivery of an increasing percentage of uranium at spot market prices. Table 5 contains a breakdown of 1983 data similar to Table 2.

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ANALYSIS & COMMENTARY

Table 1

1984 URANIUM DELIVERIES BY PRICING CATEGORY

(Millions of pounds U_3O_8 equivalent)
(number of contracts shown in parentheses)

Buyer Group	Fixed Price		Negotiated Price		Spot Price		Total Delivery to Buyer Group	
European User	22.7	(33)	8.4	(12)	4.7	(16)	35.8	(61)
US User	17.5	(43)	2.1	(2)	13.9	(43)	33.5	(88)
Other User	16.9	(40)	14.0	(18)	0.8	(3)	31.7	(61)
Non-User	5.2	(6)	2.0	(1)	4.4	(18)	11.6	(25)
TOTAL	62.3	(122)	26.5	(33)	23.8	(80)	112.6	(235)

Table 2

1984 URANIUM SELLERS' PRODUCTION AND DELIVERIES

(Millions of pounds U_3O_8 equivalent)

Region	1984 Production	Deliveries to Users	Deliveries to non-Users	Total Deliveries	Producer Inventory Additions[1]
Australia	10.3	8.6	0.0	8.6	1.7
Canada	27.9	25.3	2.7	28.0	(0.1)
France and Central Africa	19.0	14.9	0.5	15.4	3.6
Southern Africa	24.0	16.5	6.8	23.3	0.7
USA	15.6	24.8	1.0	25.8	(10.2)
Other Producers	2.2	1.7	0.2	1.9	0.3
Non-Producers	—	9.2	0.4	9.6	—
TOTAL	99.0	101.0	11.6	112.6	(4.0)

[1] Includes actual inventory changes and redeliveries within the year.

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A tendency toward increased use of the spot market, either directly or as a pricing method in long-term contracts, probably reflects the following factors:

1. A strong secondary market now exists.
2. The uranium market is coming of age. Buyers and sellers are becoming increasingly sophisticated and market information is more readily available to all participants. This maturity enables both buyers and sellers to have more confidence in the spot market.
3. There is strong pressure on some buyers, especially US utilities, to buy at spot-related prices, even under long-term contracts.

An Analogy to Another Commodity

Increasing market maturity, in the case of other commodities, has led to decreased dominance of producer (contract) prices. The aluminum market is a recent example of such a change. Through the early 1970s, the aluminum producers had fairly tight control over market prices, but the situation changed rapidly in the mid-1970s, and in late 1978, the London Metal Exchange (LME) finally introduced its first aluminum contract, based on a quoted LME spot price. Reasons for the change included:

1. The 1973-74 energy shock substantially boosted the smelting cost of some operators, especially in the USA.
2. New producers with lower production costs, chiefly lower energy costs, were then able to enter the market, causing dislocation of traditional supply channels.
3. A strong secondary market also developed in the 1970s. By 1984, an estimated 31 percent of Western World aluminum output was of secondary (recycled) origin.
4. The LME contract introduced in 1978 encouraged spot trading.

While we cannot carry the analogy too far for uranium because of the substantial differences between the two markets, there are a few indications which suggest a similar trend toward maturity in the uranium market:

1. A geopolitical shift in the uranium market is occurring, and new lower-cost uranium producers have become important, displacing some traditional supply channels.
2. A strong secondary uranium market has developed and shows signs of remaining strong.
3. At present there is no equivalent in uranium to the LME contract, but the universality of the "fuel adjustment clause" in the USA has been a strong independent driving force prompting US utilities to seek contracts with spot-market-related pricing provisions. Under the fuel adjustment clause, utilities can pass fuel costs directly through to customers, provided that the costs are reasonably and prudently incurred. Regulatory agencies generally have interpreted the "reasonable and prudent" provision to mean purchasing at about the level of spot market price in effect at the time of delivery. Thus, regulatory agencies generally allow purchases at spot market or less, but any increment above spot market usually must be absorbed by the utility.

Table 3

1984 URANIUM DELIVERIES BY PRICING CATEGORY
WHERE "SPOT" INCLUDES DELIVERIES CURRENTLY "FIXED"
BECAUSE OF HIGH FLOOR PRICES
(Millions of pounds U_3O_8 equivalent)
(number of contracts shown in parentheses)

Buyer Group	Fixed Price		Negotiated Price		Spot Price		Total Delivery to Buyer Group	
European User	18.3	(22)	8.4	(12)	9.1	(27)	35.8	(61)
US User	15.9	(38)	2.1	(2)	15.5	(48)	33.5	(88)
Other User	10.8	(32)	14.0	(18)	6.9	(11)	31.7	(61)
Non-User	5.2	(6)	2.0	(1)	4.4	(18)	11.6	(25)
TOTAL	50.2	(98)	26.5	(33)	35.9	(104)	112.6	(235)

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Conclusion

It remains to be seen if the present tendency toward increased use of the spot market will continue, but the forces appear to be working in that direction. Other commodities have endured similar transitions, and in a typical mature commodity market there is a very close relationship between the contract market and the spot market; indeed, they are often the same. For example, nearly all of the free world's copper production is sold at the LME (or another similar exchange) price at the time of delivery, whether it is sold under long-term or spot contracts.

In conclusion, it appears that the spot market has become an integral factor in the uranium market. Lessons from other commodities as well as driving forces present in the market today suggest that this tendency will continue.

Table 4

1983 URANIUM DELIVERIES BY PRICING CATEGORY
(Millions of pounds U_3O_8 equivalent)
(number of contracts shown in parentheses)

Buyer Group	Fixed Price		Negotiated Price		Spot Price		Total Delivery to Buyer Group	
European User	20.7	(32)	9.1	(13)	5.2	(13)	35.0	(58)
US User	19.7	(51)	1.5	(1)	7.0	(36)	28.2	(88)
Other User	16.5	(37)	13.8	(18)	0.6	(3)	30.7	(64)
Non-User	4.7	(6)	2.0	(1)	7.1	(31)	13.8	(38)
TOTAL	61.4	(132)	26.4	(33)	19.9	(83)	107.7	(248)

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Table 5

1983 URANIUM SELLERS' PRODUCTION AND DELIVERIES
(Millions of pounds U_3O_8 equivalent)

Region	1983 Production	Deliveries to Users	Deliveries to non-Users	Total Deliveries	Producer Inventory Additions[1]
Australia	8.4	9.6	0.0	9.6	(1.2)
Canada	18.9	20.1	1.4	21.5	(2.6)
France and Central Africa	20.0	14.5	0.3	14.8	5.2
Southern Africa	25.5	16.5	7.2	23.7	1.8
USA	21.2	25.3	1.8	27.1	(5.9)
Other Producers	1.7	1.0	0.5	1.5	0.2
Non-Producers	—	6.9	2.6	9.5	—
TOTAL	95.7	93.9	13.8	107.7	(2.5)

[1] Includes actual inventory changes and redeliveries within the year.

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NUEXCO

RECENT DEVELOPMENTS

CANADA

The partners of the Waterbury Lake Joint Venture have announced increased reserve estimates for the Cigar Lake uranium deposit. The mine is located in northern Saskatchewan, approximately 115 kilometers north of the Key Lake deposit. Estimates of the main mineralized pod indicate reserves of approximately 285 million pounds U_3O_8 (110,000 metric tons of uranium) at an average grade of 14 percent U_3O_8 (12 percent uranium). Additional inferred reserves at its western extension amount to approximately 100 million pounds U_3O_8 at an average grade of 4.7 percent U_3O_8. These estimates refer to in-place reserves; recoverable reserves are subject to the mining methods used.

Table 6

OWNERSHIP OF CIGAR LAKE

Company	Percent Ownership
SMDC[1]	50.75
Cogema Canada Ltd.	32.625
Idemitsu Uranium Exploration Canada Ltd.	12.875
Corona Grande[2]	3.75

[1] SMDC = Saskatchewan Mining Development Corporation.
[2] A wholly-owned subsidiary of Cogema Canada Limited.

Table 6 lists the ownership of the Cigar Lake venture. Cogema Canada, which has operated the Waterbury Lake Joint Venture since 1980, made the initial discovery in 1981. During 1983, 65 holes drilled on the primary structure were the basis of reserve estimates; new estimates based on drilling carried out through the end of 1984 surpass earlier expectations of size and ore grade.

Exploration work carried out to date includes a geostatistical estimation of the reserves in the main mineralization, which occurs as a flat lens, 1 to 20 meters thick, extending over a length of 650 meters. Average depth is 430 meters, and the main mineral association is uraninite/nickel-cobalt arsenides. In addition to the drilling program, various pre-development studies took place in 1984, focusing on geotechnical, metallurgical, and environmental aspects of the project.

Exploration drilling and development studies will continue in 1985. The Waterbury Lake Joint Venture partners plan to establish a joint operating corporation, the Cigar Lake Mining Corporation (CLMC), comprised of mining engineers, geotechnicians and environmental specialists assigned to the project from SMDC, Cogema Canada, and Idemitsu. CLMC plans to study the feasibility of the project for the next three to five years. Commercial development of the deposit probably will commence early in the 1990s.

UNITED STATES

House of Representatives members have introduced legislation that would restrict nuclear trade, including purchases of uranium, with South Africa. The House bills (HR 1133, 1135 and 1098) would restrict the exchange of nuclear technology with South Africa as well as the US import of uranium from that country. Two of the bills, introduced by Rep. Charles Rangel (D-N.Y.), would prohibit export of nuclear material, equipment, and technology, and the US Tariff Schedules would be amended to prohibit the importation of coal and uranium from South Africa or Namibia. A third bill, introduced by Del. Walter Fauntroy (D-D.C.), which would prohibit the importation of South African coal and uranium, also would prohibit exports to South Africa of nuclear goods or technology. In addition, the bill would prohibit new investments in South African businesses and the importation of Krugerrands.

Various arguments against nuclear trade with South Africa have been expressed in the Congressional Record and in letters from Congressmen to former DOE Secretary Donald Hodel. These arguments include the following:

- The objective of seeking new signatories to the Nonproliferation Treaty (NPT) might be jeopardized.
- Other African nations could drop their support for the NPT in response to such trade approvals. The loss of a nation or bloc of nations could seriously undermine the future of the treaty in addition to the success of the Nonproliferation Treaty Review Conference in September.
- US trade policy should favor signatories of the NPT to avoid the impression that the USA is indifferent to the NPT status of other nations.

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The issue of safeguarded material remains a central conflict between South Africa and the NPT, although South Africa has agreed to place its Valindaba enrichment plant under safeguards. No agreement has been reached regarding the pilot enrichment facility at Pelindaba. In February 1984, DOE suspended the Electricity Supply Commission of South Africa's (Escom) two enrichment contracts because of a lingering safeguards dispute. Escom had been unable to export enriched product from the USA because of certain provisions in the Nuclear Nonproliferation Act of 1978 which pertain to non-weapons states. The US State Department requested the suspension following an announcement by South Africa's Atomic Energy Corporation that it would require safeguards as a condition of exporting nuclear material or technology.

Hodel responded to the arguments, stating that progress has been made as a result of US dialogue with South Africa, and that the country has resumed discussions with the International Atomic Energy Agency (IAEA) concerning safeguards to the Valindaba enrichment facility. Bills similar to the ones introduced in Congress in February have appeared before, but have been largely unsuccessful. It is likely, considering the Reagan administration's stance of "constructive engagement" with South Africa, that the bills will fail to gain the necessary Congressional support.

* * *

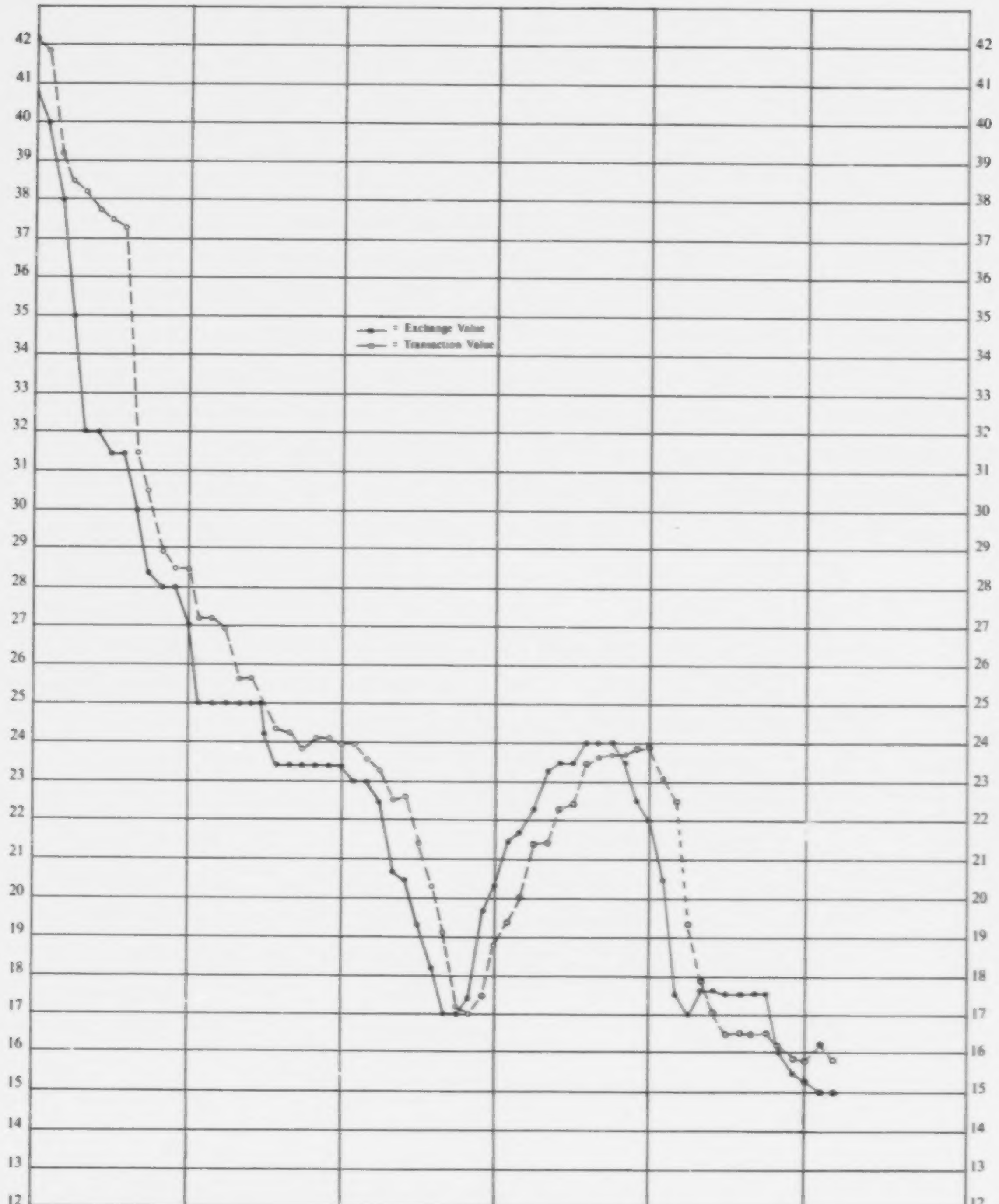
Long Island Lighting Company's (LILCO) Shoreham nuclear power plant received NRC approval to begin low-power operation. The approval follows numerous hearings and discussions regarding the feasibility of the 820-MWe BWR. A low-power license has been pending since a special board to consider the NRC's procedure for licensing the plant was set up in early 1984. The plant's major opponents, Suffolk County and the State of New York, immediately requested a stay of the NRC order, filing a suit in the US Court of Appeals for the D.C. Circuit. In addition, an NRC appeal board is considering the opponents' appeal.

The plant has had a long history of problems and delays which has fueled public criticism. Heavy financial burdens remain the chief obstacle to commercial operation. In an effort to save money, LILCO withdrew as an 18-percent partner in Niagara Mohawk's Nine Mile Point Unit 2 nuclear plant in early 1984. (LILCO later reached an agreement with Niagara Mohawk to resolve the defaulted partnership.) Shortly thereafter, the utility omitted its common stock dividend and eliminated some jobs. In October 1984, an Atomic Safety and Licensing Board recommended a low-power license for Shoreham to help ease the utility's financial problems.

Furthermore, opponents of the plant contend that LILCO's emergency evacuation plan is inadequate, an issue which is under consideration in a state court. Opponents argued that low-power tests should be postponed until the court rules. LILCO's evacuation plan was approved by federal authorities but is opposed by Suffolk County; New York Governor Mario Cuomo supports the county's position. LILCO, on the other hand, filed a lawsuit against Suffolk County in June 1984, charging $4 billion in damages if the county is successful in keeping the plant from operating.

HISTORICAL MARKET DATA

EXCHANGE AND TRANSACTION VALUES
SINCE JANUARY 1980
Determined as of the last day of the month indicated



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HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	—	—	—	—	—	—	—	6.35	6.35	6.40	6.45	6.50
1969	—	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	32.50	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00
1981	25.00	25.00	25.00	25.00	25.00	24.25	23.50	23.50	23.50	23.50	23.50	23.50
1982	23.00	23.00	22.50	20.75	20.50	19.25	18.25	17.00	17.00	17.50	19.75	20.25
1983	21.50	21.75	22.25	23.25	23.50	23.50	24.00	24.00	24.00	23.50	22.50	22.00
1984	20.50	17.50	17.00	17.75	17.75	17.50	17.50	17.50	17.50	16.00	15.50	15.25
1985	15.00	**15.00**										

HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	—	—	—	—	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38.40	37.90	37.60	37.30	31.60	30.60	29.00	28.70	27.70
1981	27.20	27.20	27.00	25.70	25.70	24.50	24.40	24.30	23.90	24.10	24.10	24.00
1982	24.00	23.70	23.40	22.60	22.70	21.50	20.30	19.10	17.30	17.00	17.55	18.80
1983	19.35	20.00	21.35	21.40	22.35	22.45	23.50	23.60	23.65	23.65	23.85	23.85
1984	23.05	22.50	19.25	17.90	17.00	16.50	16.60	16.40	16.55	16.05	15.90	15.90
1985	16.20	**15.70**										

HISTORICAL CONVERSION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U as UF_6)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	1.20	1.20	1.20	1.40	1.15	1.15	1.15	1.10	1.10	1.10	1.20	1.20
1982	1.20	1.20	1.20	1.20	1.00	1.00	1.00	0.90	1.10	1.60	1.45	1.45
1983	1.20	1.40	1.40	1.20	1.20	1.20	1.10	1.10	1.00	0.60	0.60	0.60
1984	0.60	0.30	0.80	0.80	0.80	0.00	0.00	0.80	1.00	1.00	0.80	0.80
1985	1.00	**1.00**										

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GOVERNMENT STATISTICS

AUSTRALIA

	Price Index of Materials Used in Manufacturing Industry—All Groups[1] (1969=100)	Award Rates of Pay Indexes Australia—Adult Males In Mining Wage and Salary Earners, Weekly Rates[2] (1976=100)
1983 Avg.	401.2	181.8
Nov 1983	395.5	188.3
Dec 1983	399.2	188.1
Jan 1984	399.2	188.6
Feb 1984	402.5	188.5
Mar 1984	403.9	188.3
Apr 1984	404.2	196.2
May 1984	403.8	197.0
Jun 1984	404.9	197.0
Jul 1984	408.5	197.0
Aug 1984	413.3	197.0
Sep 1984	412.1	197.0
Oct 1984	408.6	197.0
Nov 1984	407.2	197.0
Dec 1984	—	197.0

P = Preliminary R = Revised since last month

CANADA

		Wage-earner Data: Average Hourly Earnings (C$)[2]					
	Industry Selling Price Index: Manufacturing[1] (1971=100)	Uranium Mines (SIC 057)	Metal Mines* (SIC 051-059)	Mines, Quarries and Oil Wells[3] (SIC 051-099)	Primary Metal Industries Non-ferrous[4]		Chemicals and Chemical Products[5] (SIC 372-379)
					(SIC 296)	(SIC 298)	
1983 Avg.	298.8	—	—**	14.30	—	—	11.17
Jan 1984	305.4	17.74	15.27	14.74	11.91	10.84	11.69
Feb 1984	306.6	17.78	15.59	14.90	12.04	10.82	11.51
Mar 1984	308.7	18.05	15.52	14.82	12.14	10.84	11.58
Apr 1984	310.5	18.06	15.83	15.10	11.96	10.34	11.63
May 1984	310.6	18.48	15.64	15.06	12.11	10.16	11.65
Jun 1984	311.0	18.08	15.48	14.80	12.38	10.40	11.66
Jul 1984	312.7	17.81	15.72	14.92	12.53	10.18	11.82
Aug 1984	312.7R	17.24	15.36	14.92	12.44	10.34	11.78
Sep 1984	312.3R	17.68	15.96	15.34	12.51	10.52	11.90
Oct 1984	312.3	17.64	16.15	15.26	12.69	10.56	11.96
Nov 1984	313.6R	18.04R	16.13R	15.43R	12.47	10.51R	11.96R
Dec 1984	314.3R	17.96P	16.21P	15.57P	12.17P	10.45P	12.00P
Jan 1985	315.5P	—	—	—	—	—	—

P = Preliminary R = Revised since last month

For annual averages prior to 1983, and for notes pertaining to these statistics, see pages 23-26 of Report 190 of June 1984.

*The 1980 average for Metal Mines was incorrectly reported as 10.59. The correct average is 10.58 (see Report 190).

**Two different methods were used in the 1983 "Metal Mines" category in reporting survey data, and Statistics Canada did not publish a 1983 average. The March 1983 figure for the old method was 14.73 and for the new method was 14.84. The published average for 1983 in Report 190 was a Nuexco calculation based on the available monthly statistics for 1983 with the exception of the March figure, where only the 14.84 value was taken into account.

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REPUBLIC OF SOUTH AFRICA

	Average Declared Working Costs per per Metric Ton of Gold Ore Milled (Rand)[1]	Tonnage-Weighted Index of Average Working Costs per Metric Ton of Gold Ore Milled (March 1982=100)[2]	Consumer Price Index[3] (1975=100)[4]	Producer Price Index All Groups[5] (1975=100)	Total Employment in Mining and Quarrying (Code 35)[6]	Total Salaries and Wages in Mining and Quarrying (1,000 Rand) (Code 40)[6]
1983 Avg.	51.87	115.0	262.2	274.8	696,579	3,644,772
Dec 1983	53.70	119.6	273.2	283.7	690,750	333,595
Jan 1984	—	—	274.7	283.3	689,807	326,619
Feb 1984	—	—	278.4	286.5	702,553	335,906
Mar 1984	55.30	123.1	281.9	288.0	715,628	342,332
Apr 1984	—	—	286.1	290.2	712,963	327,550
May 1984	—	—	288.3	292.6	710,040	327,937
Jun 1984	56.95	126.2	291.2	295.3	717,009	347,121
Jul 1984	—	—	295.1	296.0	717,121	369,964
Aug 1984	—	—	297.0	300.8	721,905	361,357
Sep 1984	60.64	133.2	299.9	304.1	721,470	359,218
Oct 1984	—	—	303.7	308.7	717,865	363,755
Nov 1984	—	—	307.4	312.8	717,396	369,771
Dec 1984	62.92	138.6	309.4	315.9	—	—
Jan 1985	—	—	177.1*	—	—	—

*The basis for calculation for this index has been revised to January 1980 = 100.

UNITED STATES

	Producer Price Index[1]		Consumer Price Index[2]	GNP Implicit Price Deflator[3]	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[4]			
	Industrial Commodities (1967=100)	All Commodities (1967=100)	(1967=100)	(1972=100)	Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)	Electric and Electronic Equipment (SIC 36)
1983 Avg.	315.8	303.1	298.4	215.63	12.57	13.43	10.59	8.65
Dec 1983	318.4	306.1	303.5	218.53	12.75	13.33	10.90	8.84
Jan 1984	319.1	308.0	305.2	—	12.67	13.38	10.91	8.88
Feb 1984	320.6	308.9	306.6	—	12.81	13.34	10.90	8.86
Mar 1984	321.9	311.0	307.3	220.58	12.85	13.33	10.95	8.88
Apr 1984	322.5	311.4	308.8	—	12.91	13.30	10.97	8.89
May 1984	323.3	311.7	309.7	—	12.99	13.37	11.02	8.89
Jun 1984	323.9	311.4	310.7	222.40	12.96	13.40	11.03	8.91
Jul 1984	324.0	312.0	311.7	—	13.02	13.36	11.12	8.95
Aug 1984	323.5	310.9	313.0	—	13.10	13.51	11.13	9.00
Sep 1984	322.3	309.5	314.5	224.57R	13.20	13.39	11.23	9.08
Oct 1984	323.2	309.4	315.3	—	13.23	13.53	11.32	9.09
Nov 1984	323.8	310.4	315.3	—	13.23	13.76	11.35	9.15
Dec 1984	323.0	309.9	315.5	226.10R	13.21	13.65	11.35	9.26
Jan 1985	323.2	309.8	316.1	—	—	—	11.37	9.33

P = Preliminary R = Revised since last month

For annual averages prior to 1983, and for notes pertaining to these statistics, see pages 23-26 of Report 190 of June 1984.

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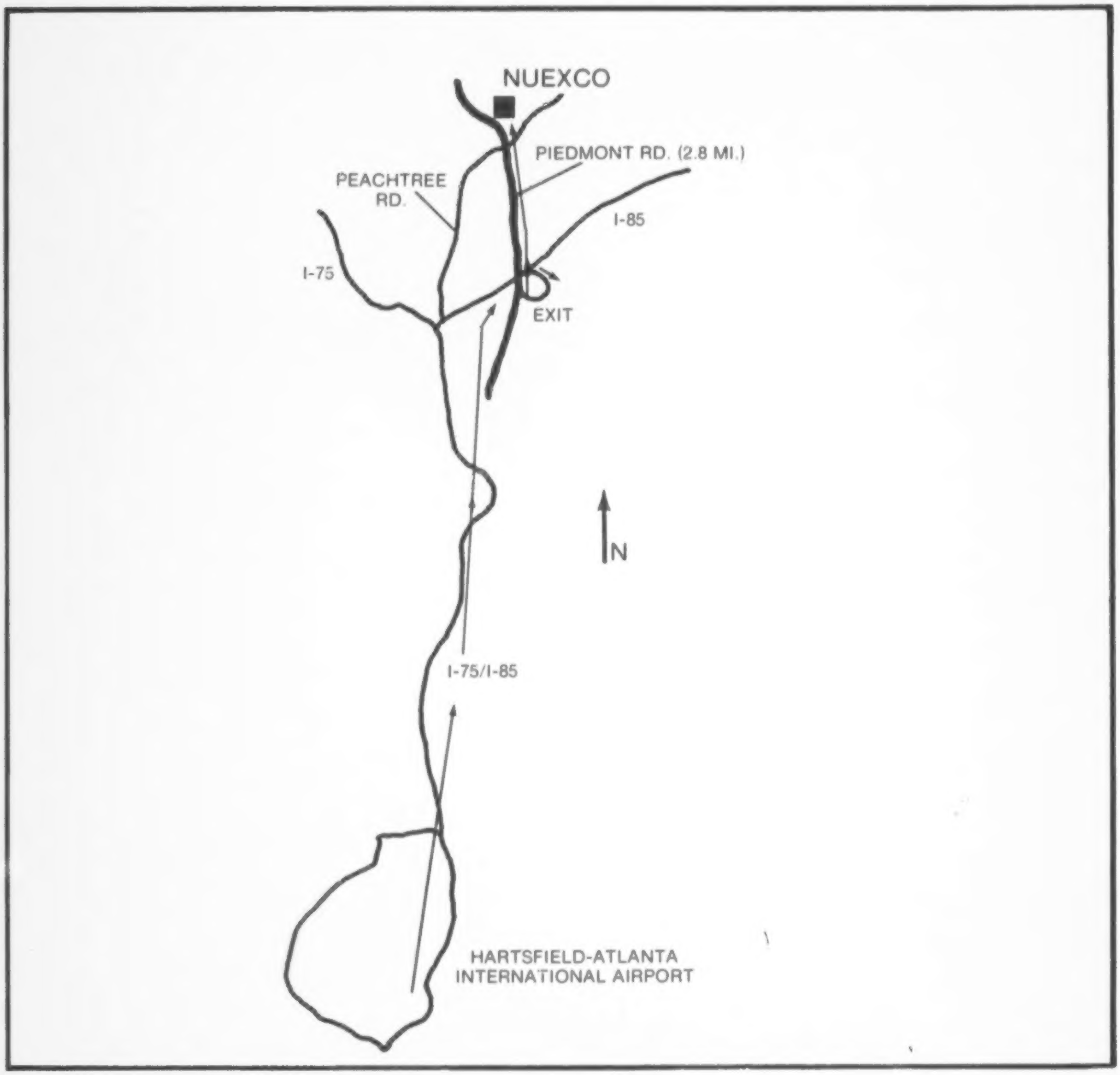
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NUEXCO

EXECUTIVE SUMMARY
REPORT 199
(All data as of February 28, 1985)

Exchange Value
$15.00, unchanged

The **Exchange Value** is **$15.00** per pound U_3O_8, unchanged since last month. Nine recent natural uranium sales are reported, involving approximately 2.1 million pounds U_3O_8 equivalent. Eight involved delivery prior to 1986, and six met the conditions for inclusion in the Transaction Value. Two additional transactions, totaling less than 50 thousand pounds U_3O_8 equivalent, involved enriched uranium.

Supply-Demand Ratio
fell to 2.3:1

Active spot and near-term **uranium supply** amounts to **5.3 million** pounds U_3O_8 equivalent, up 1.1 million pounds since last month. Active spot and near-term **uranium demand** totals **2.3 million** pounds, up 1.0 million pounds. The spot and near-term **supply-demand ratio** declined to **2.3:1.**

Transaction Value
fell to $15.70

The **Transaction Value** is **$15.70** per pound U_3O_8, down $0.50 since last month. The calculation includes 13 transactions involving a total of 2.3 million pounds U_3O_8 and equivalent UF_6, and covers a period of 4 months.

Loan Use Charge Rate
declined to 5%

The **Loan Use Charge Rate** fell to **5 percent** per annum.

Conversion Value
unchanged at $1.00

The **Conversion Value** is **$1.00** per pound U as UF_6, unchanged since last month. Two secondary market conversion transactions are reported, involving approximately 200,000 pounds U as UF_6. Active secondary market supply for conversion services for delivery within three years totals 300 thousand pounds U as UF_6. Active demand totals 255 thousand pounds U as UF_6.

SWU Values:
$102 for DOE-origin (FY85)
$20 discount for FY86
$80 for non-DOE origin
calendar year 1985
$88 for calendar year 1986

The **SWU Values** for DOE origin at .3 tails and certifiable as excess, are **$102** per SWU for FY85 delivery, and **$20** per SWU discount from DOE base price for FY86 delivery. SWU Values for other SWUs (non-DOE or non-certifiable) are **$80** per SWU for calendar year 1985 delivery, and **$88** per SWU for calendar year 1986 delivery. One secondary market SWU transaction is reported, involving less than 50 thousand SWUs.

Analysis & Commentary

Nuexco President Jim Vaughan, in a speech given at the Atomic Industrial Forum's Fuel Cycle Conference, concluded that the spot market has become an integral factor in the uranium market and that this tendency probably will continue as the market matures.

Canada

The Waterbury Lake Joint Venture partners have announced increased reserve estimates for the Cigar Lake uranium deposit.

United States

Legislation introduced into the House of Representatives would prohibit the importation of uranium or coal from South Africa, and would also restrict other aspects of nuclear trade.

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NUEXCO REPORT 199 FIGURES OF THE MONTH (February 28, 1985)	This Month (Report 199)	Last Month (Report 198)	12 Months Ago (Report 187)
Exchange Value[1]	15.00	15.00	17.50
Transaction Value[1]	15.70	16.20	22.50
Loan Use Charge Rate[2]	5%	6%	6%
Conversion Value[3]	1.00	1.00	0.30
Near-Term Uranium Supply[4]	5.3	4.2	5.9
Near-Term Uranium Demand[5]	2.3	1.3	1.3
Near-Term Supply-Demand Ratio	2.3	3.3	4.5
Recent Uranium Sales:			
Number of Transactions[6]	9	1	4
Quantity of Material[7]	2.1	0.1-0.3	1.5-3.0
Nuexco SWU Values:[8]			
DOE origin, certifiable as excess, 0.3 tails assay			
FY85 delivery	102	112	—
FY86 delivery	20[9]	15[9]	—
Other SWUs (non-DOE or non-certifiable)			
1985 delivery	80	80	—
1986 delivery	88	90	—
USDOE SWU Prices:			
USEC	135.00	135.00	135.00
AFC	153.00[10]	153.00[10]	138.65
Requirements	157.00[10]	157.00[10]	149.85
Market Value of Enriched UF$_6$[11] [12]:			
2.5 w/o U$_{235}$	481	506	532
3.0 w/o U$_{235}$	621	656	685
3.5 w/o U$_{235}$	765	808	841
4.0 w/o U$_{235}$	911	964	999

---

[1] US $ per pound U$_3$O$_8$ equivalent.

[2] Per annum.

[3] US $ per pound U as UF$_6$.

[4] Active inquiries to sell, for delivery within 12 months after contract signing (millions of pounds U$_3$O$_8$).

[5] Active inquiries to purchase, for delivery within 12 months after contract signing (millions of pounds U$_3$O$_8$).

[6] Uranium sales only; does not include loans, conversion, or SWU transactions.

[7] Millions of pounds U$_3$O$_8$, equivalent.

[8] US $ per SWU.

[9] Discount from USEC base price on delivery.

[10] Effective 10/1/84.

[11] Calculated using the Nuexco Exchange Value, Conversion Value, and 0.30 percent tails assay. From 10/31/83 through 2/29/84, calculations used the Nuexco SWU Value for DOE origin and FY84 delivery. As of 3/31/84, calculations use the Nuexco SWU Value for DOE origin and FY85 delivery.

[12] US $ per KgU as UF$_6$, rounded to the nearest $.

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APRIL 1985 NUMBER 200

MONTHLY REPORT

ON THE NUCLEAR FUEL MARKET

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MONTHLY REPORT ON THE NUCLEAR FUEL MARKET
April 1985 No. 200

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PRICING

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To Our Readers

Nuexco has just mailed a 1984 Annual Review to our full-service subscribers. This 54-page special report covers nuclear fuel market developments throughout the world in 1984 and early 1985. In particular, it analyzes the condition and pricing trends of the spot/near-term markets for uranium and secondary market enrichment services. Nuexco market values for 1984 have also been brought together in a series of tables for reference.

If you would like to purchase copies of the 1984 Annual Review Special Report, they are available for $175 each. Please contact our Headquarters:

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PRICING

NATURAL URANIUM AND SECONDARY MARKET CONVERSION

The **Exchange Value** as of March 31, 1985 is **$15.00** per pound U_3O_8, unchanged since last month. **Active supply** of natural uranium (U_3O_8 and UF_6) for spot or near-term delivery totals **4,250,000** pounds equivalent U_3O_8 as concentrates or UF_6, down 20 percent since last month. The corresponding figure for **active demand** is **4,055,000** pounds, up 80 percent. The spot and near-term **supply-demand ratio** fell to **1.0:1.**

The *Current Market Data* section of this Report lists eleven natural uranium sales transactions, involving a total of approximately 2,100,000 pounds equivalent U_3O_8. Three of the transactions reported this month involved natural UF_6, all involved deliveries before 1986, and ten met the criteria for inclusion in the current Transaction Value calculation.

The **Transaction Value** as of March 31, 1985 is **$15.05** per pound U_3O_8, down $0.65 since last month. The current Transaction Value includes 16 transactions involving a total of 2.4 million pounds U_3O_8 or equivalent UF_6 and covers a period of 3 months. The Transaction Value fell as a result of the large number of transactions added to the calculation this month, allowing the removal from the calculation of two months' transactions involving over one million pounds of uranium. Those transactions, most of which took place at the end of 1984, involved prices consistent with the slightly higher Exchange Values ($15.50 and $15.25) of those months.

The **Loan Use Charge Rate** as of March 31, 1985 is unchanged at **5 percent** per annum, as a lender continued to offer a substantial quantity of material at that rate.

* * *

The uranium market was unusually active in March. Transactions continued to take place slightly above and below the $15.00 level, and there were few indications of major price firming. Small quantities of material tended to command lower prices, but there was enough activity on both sides of the market to keep the Exchange Value temporarily stable. The heightened level of buyer interest has halted the slow decline of prices that was underway at the end of 1984.

* * *

The **Conversion Value** is **$1.00** per pound U in UF_6, unchanged since last month. One secondary market conversion transaction is reported, involving approximately 100,000 to 300,000 pounds U in UF_6. Active supply of secondary market conversion services for delivery within three years totals 110,000 pounds U as UF_6. Active secondary market demand for conversion amounts to 255,000 pounds U in UF_6.

It is becoming more and more difficult to characterize the secondary conversion market with only one price. Two distinctly different combinations of buyer-seller motivations are making two apparently conflicting types of pricing strategies necessary for the completion of transactions.

1. Sellers of natural UF_6 find it necessary to offer discounts of 25 to 35 percent (off the Nuexco Conversion Value) on the conversion component of their material in order to stimulate buyer interest.
2. Conversely, buyers that want secondary market conversion services (as opposed to UF_6) need to pay as much as a 50-percent premium (on the Nuexco Conversion Value) to attract a willing seller. Only one seller of conversion services is actively in the market at present, yet there are several buyers.

Thus, the conversion component contained in UF_6 is anywhere from one-half to three-fourths the value of conversion services purchased on the secondary market. That such apparently contradictory situations are present in the market is testimony to the degree of imperfection in the nuclear fuel market, imperfection which is most severe in conversion, the interface between U_3O_8 and UF_6. In theory, the value of UF_6 should be equal to the sum of its U_3O_8 and conversion components. However, under the present market conditions, that equality does not hold. In fact, UF_6 is worth *less than* the sum of its constituents. Hence the need for UF_6 sellers to discount conversion, while conversion buyers need to pay a premium.

ENRICHED URANIUM AND SWUS

The Nuexco **SWU Values** as of March 31, 1985 are:

1. For **DOE origin,** a tails assay of 0.30 weight-percent U_{235}, and certifiable as excess:
    a. For FY85 delivery, $98 per SWU, down 4;
    b. For FY86 delivery, $25 discount from the USEC base price on delivery (20 last month);
2. For **other** SWUs (includes DOE origin SWUs not certifiable as excess and non-DOE origin SWUs):
    a. For delivery in calendar year 1985, $80 per SWU, unchanged;
    b. For delivery in calendar year 1986, $85 per SWU, down 3.

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PRICING

One secondary market SWU transaction is reported, involving approximately 300 to 600 thousand SWUs of Eurodif origin.

* * *

The continuing drop in the value for SWUs certifiable as excess for delivery in fiscal year 1985 reflects the almost complete lack of active demand for FY85 material. One active buyer remains, and the rest of the SWU demand has shifted to the FY86 market as it continues to develop. DOE's announcement of FY86 SWU prices is expected in the coming weeks. In the meantime, the DOE market remains glutted with sellers, applying downward pressure on prices. There is still little activity in Europe in the market for other SWUs (non-DOE or DOE SWUs not certifiable as excess). Buyers can expect prices to fall in response to DOE's offer of incentive prices for SWUs purchased for delivery in 1987 and beyond.

At the beginning of April, DOE sent letters to USEC customers proposing an incentive pricing program for enrichment. Responses in the form of bids are due April 30, 1985. Acceptance of the bids is contingent upon a large-enough response to make the program viable: perhaps as much as 2,000,000 SWUs. As reported in last month's pricing section (Report 199, March 1985), FY87 and FY88 SWUs will be priced at $90 per SWU (fixed), and FY89 and FY90 SWUs will be priced at $90 per SWU (escalated from October 1, 1988 according to the escalation formula specified in Article 4 of the USEC). Utilities will be able to purchase incentive-priced SWU for FY87-88 or for FY87-90. Other details are as follows:

1. The customer must commit to buy 100 percent of uncommitted requirements under the incentive pricing arrangement.
2. The customer may purchase more than 30 percent of requirements if that opportunity was created by a contract termination that occurred before December 31, 1983.
3. Less than 30 percent of requirements may be purchased if the opportunity to do so is a result of a contract agreed to before February 15, 1985.
4. The Variable Tails Assay Option (VTAO) may be selected between 0.2 and 0.3 percent by the utility *at no charge*. Presumably, the customer will be required to give notice according to the period established in the USEC. The customer may select only one tails assay per SWU order.

Because the utilities are required to bid to DOE, Nuexco expects that some customers will bid back different terms to DOE in order to obtain the best deal possible. It is not known whether DOE will extend the response period past the April 30 deadline.

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CURRENT MARKET DATA

March 31, 1985	Market Values	Active Supply[1] (thousands)	Active Demand[1] (thousands)
EXCHANGE VALUE	**$15.00**/lb. U_3O_8	4,250	4,055
CONVERSION VALUE	**$1.00**/lb. U in UF_6	110	255
SWU VALUES			
DOE origin, certifiable as excess, 0.3 tails assay			
FY85 delivery	**$98**/SWU		
FY86 delivery	**$25** discount/SWU		
Other SWUs (non-DOE or non-certifiable)			
calendar year 1985 delivery	**$80**/SWU		
calendar year 1986 delivery	**$85**/SWU		
LOAN USE CHARGE RATE	5%/annum	0	0

TRANSACTION VALUE

$/lb. U_3O_8	Millions of Pounds	Number of Transactions	Number of Months
15.05	2.4	16	3

[1] Supply and demand tables in the *Current Market Data* section of this Report detail the numbers for each category.

DEFINITIONS

1. The **Exchange Value** is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the date indicated.
2. The **Conversion Value** is Nuexco's judgment of the price at which spot and near-term transactions for significant quantities of conversion services could be concluded in the secondary market as of the date indicated.
3. The **SWU Values** represent Nuexco's judgment of the price at which transactions for the sale of significant quantities of SWUs of stated origin for delivery in the specified time period could be concluded as of the date indicated.
4. The **Loan Use Charge Rate** is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the date indicated.
5. The **Transaction Value** is a weighted average price of recent natural uranium sales transactions. The calculation is based on prices paid in:
   a. Transactions closed within the previous three-month period for which delivery is scheduled within one year of the transaction date;
   b. At least ten transactions;
   c. Transactions involving a sum total of at least 2 million pounds U_3O_8 equivalent.

   The sample time is extended as necessary to include these minima. Other currencies are converted to US dollars using conversion rates in effect on or near the transaction date.

DERIVATIONS AND COMMENTS

1. All Market Values are based on:
   a. Data from recently completed transactions.
   b. Data from pending transactions.
   c. Firm bids to buy or borrow, and firm offers to sell or lend.
   d. Prices purchasers or rates borrowers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy or borrow, and prices sellers or rates lenders have expressed a willingness to offer, but for which Nuexco is not aware of firm offers to sell or lend.
2. Prices associated with deliveries under old or renegotiated contracts or other than arm's-length transactions are not considered in the determination of these Market Values.
3. In the determination of the Conversion Value, Nuexco does not consider transportation charges other than those customarily provided by primary suppliers of conversion services.
4. The prices of conversion services or SWUs delivered under long-term contracts with primary suppliers are not considered in the determination of either the Conversion Value or SWU Value.
5. For the DOE SWU Values, Nuexco converts SWU prices at varying tails and product assays to equivalent SWU prices at a tails assay of 0.30 weight-percent U_{235} and a product assay of 3.0 weight-percent U_{235}, assuming feed costs corresponding to the Nuexco Exchange and Conversion Values determined as of the same date.
6. In calculating the Transaction Value, Nuexco does not account for the price of uranium delivered in connection with contracts which call for "market price" mechanisms. This exclusion applies particularly to contracts in which delivery prices are expressed as a function of future Exchange Values or any other indeterminant variable. Also excluded from the calculation are any other transactions in which the delivery price is defined in such a way that it cannot currently be determined.

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CURRENT MARKET DATA

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

	per lb. U_3O_8 in Concentrates			per kg. U in Concentrates		
Country (currency)	This Month (Mar. 31, 1985)	Last Month (Feb. 28, 1985)	12 Months Ago (Mar. 31, 1984)	This Month (Mar. 31, 1985)	Last Month (Feb. 28, 1985)	12 Months Ago (Mar. 31, 1984)
Australia (dollar)	21.28	20.76	18.12	55.31	53.97	47.11
Belgium (comm. franc)	940.44	1,001	905	2,445	2,602	2,353
Canada (dollar)	20.53	20.73	21.73	53.38	53.89	56.50
Finland (markka)	97.66	103.38	94.34	253.88	268.76	245.26
France (franc)	143.13	152.39	135.24	372.11	396.19	351.60
FRG (mark)	46.90	49.85	43.92	121.94	129.60	114.17
Italy (lira)	29,922	30,902	27,490	77,791	80,339	71,469
Japan (yen)	3,793	3,881	3,805	9,860	10,090	9,892
Netherlands (guilder)	52.80	56.24	49.53	137.26	146.22	128.78
South Africa (rand)	28.71	30.00	21.01	74.63	77.99	54.63
Spain (peseta)	2,610	2,745	2,518	6,786	7,137	6,547
Sweden (krona)	135.01	140.71	130.87	351.00	365.82	340.23
Switzerland (franc)	38.88	42.37	36.37	101.08	110.16	94.56
UK (pound)	12.20	13.76	11.71	31.72	35.78	30.43
US (dollar)	15.00	15.00	17.00	39.00	39.00	44.20

TRANSACTION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

	per lb. U_3O_8 in Concentrates			per kg. U in Concentrates		
Country (currency)	This Month (Mar. 31, 1985)	Last Month (Feb. 28, 1985)	12 Months Ago (Mar. 31, 1984)	This Month (Mar. 31, 1985)	Last Month (Feb. 28, 1985)	12 Months Ago (Mar. 31, 1984)
Australia (dollar)	21.35	21.73	20.52	55.50	56.49	53.34
Belgium (comm. franc)	943.57	1,047	1,025	2,453	2,723	2,665
Canada (dollar)	20.60	21.70	24.61	53.56	56.41	63.97
Finland (markka)	97.98	108.20	106.83	254.73	281.30	277.72
France (franc)	143.61	159.50	153.14	373.35	414.68	398.14
FRG (mark)	47.06	52.18	49.73	122.35	135.65	129.28
Italy (lira)	30,022	32,344	31,129	78,050	84,088	80,928
Japan (yen)	3,805	4,062	4,308	9,893	10,561	11,201
Netherlands (guilder)	52.97	58.87	56.09	137.72	153.04	145.82
South Africa (rand)	28.80	31.40	23.79	74.88	81.63	61.86
Spain (peseta)	2,619	2,873	2,851	6,808	7,470	7,413
Sweden (krona)	135.46	147.28	148.19	352.17	382.89	385.26
Switzerland (franc)	39.01	44.35	41.19	101.42	115.30	107.07
UK (pound)	12.24	14.40	13.26	31.82	37.45	34.46
US (dollar)	15.05	15.70	19.25	39.13	40.82	50.05

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[1] Calculated using currency exchange rates published in the *Wall Street Journal* on March 29, 1985.

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CONVERSION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb. U as UF_6 This Month (Mar. 31, 1985)	per lb. U as UF_6 Last Month (Feb. 28, 1985)	per lb. U as UF_6 12 Months Ago (Mar. 31, 1984)	per kg. U as UF_6 This Month (Mar. 31, 1985)	per kg. U as UF_6 Last Month (Feb. 28, 1985)	per kg. U as UF_6 12 Months Ago (Mar. 31, 1984)
Australia (dollar)	1.42	1.38	0.85	3.13	3.05	1.88
Belgium (comm. franc)	62.70	66.71	42.60	138.22	147.07	93.91
Canada (dollar)	1.37	1.38	1.02	3.02	3.05	2.25
Finland (markka)	6.51	6.89	4.44	14.35	15.19	9.79
France (franc)	9.54	10.16	6.36	21.04	22.40	14.03
FRG (mark)	3.13	3.32	2.07	6.89	7.33	4.56
Italy (lira)	1,995	2,060	1,294	4,398	4,542	2,852
Japan (yen)	252.84	258.73	179.05	557.43	570.41	394.74
Netherlands (guilder)	3.52	3.75	2.33	7.76	8.27	5.14
South Africa (rand)	1.91	2.00	0.99	4.22	4.41	2.18
Spain (peseta)	174.00	183.02	118.50	383.61	403.48	261.25
Sweden (krona)	9.00	9.38	6.16	19.84	20.68	13.58
Switzerland (franc)	2.59	2.82	1.71	5.71	6.23	3.77
UK (pound)	0.81	0.92	0.55	1.79	2.02	1.21
US (dollar)	1.00	1.00	0.80	2.20	2.20	1.76

SWU VALUES EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	DOE SWU FY85 (March 31, 1985)	Non-DOE SWU 1985 delivery (March 31, 1985)	Non-DOE SWU 1986 delivery (March 31, 1985)
Australia (dollar)	139.01	113.48	120.57
Belgium (comm. franc)	6,144	5,016	5,329
Canada (dollar)	134.15	109.51	116.36
Finland (markka)	638.02	520.83	553.39
France (franc)	935.11	763.36	811.07
FRG (mark)	306.44	250.16	265.79
Italy (lira)	195,492	159,585	169,559
Japan (yen)	24,779	20,228	21,492
Netherlands (guilder)	344.95	281.59	299.19
South Africa (rand)	187.56	153.11	162.68
Spain (peseta)	17,052	13,920	14,790
Sweden (krona)	882.09	720.07	765.08
Switzerland (franc)	254.02	207.36	220.32
UK (pound)	79.71	65.07	69.13
US (dollar)	98.00	80.00	85.00

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[1] Calculated using currency exchange rates published in the *Wall Street Journal* on March 29, 1985.

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CURRENT MARKET DATA

RECENT TRANSACTIONS[1]

Uranium Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U_3O_8 equivalent)	Approximate Price as Percent of Current E.V.	Seller	Buyer	Remarks
3381	1985	less than 50	100	US Producer	US Producer	
3380	1985	less than 50	98	US Producer	US Producer	
3371	1985	601-1,000	R[2]	US Utility	European Utility	UF_6. Inventory sale.
3370	1985	301-600	93	US Utility	European Utility	UF_6. Inventory sale.
3369	1985	101-300	93	US Utility	US Utility	UF_6. Inventory sale.
3367	1985	less than 50	94	US Producer	US. Utility	
3364	1985	101-300	101	US Producer	US Producer	
3358	1985	301-600	98	US R[2]	US R[2]	
3356	1985	less than 50	97	US R[2]	US R[2]	
3346	1985	less than 50	94	Trader	US Utility	
3344	1985	less than 50	95	Trader	US Utility	

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[1] Transactions listed are not limited to those in which Nuexco was involved, but also include others of which Nuexco is aware.

[2] The notation *R* means that Nuexco either does not know, or that Nuexco has restricted that information to protect client confidentiality.

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RECENT TRANSACTIONS[1] *(continued)*

Secondary Market Conversion Services

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U equivalent)	Approximate Price as Percent of Current C.V.	Seller	Buyer	Remarks
3357	1985	101-300	65	R[5]	US Utility	

Enrichment Services
Secondary Market Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity[2] (thousands of SWUs)	Approximate Price[3] as Percent of Current SWU Value[4]	Seller Group	Buyer Group	SWU Origin	Remarks
3341	1986-1988	301-600	see remarks	European Entity	US Utility	Eurodif	Series of fixed prices.

[1] Transactions listed are not limited to those in which Nuexco was involved, but also include others of which Nuexco is aware.

[2] If tails assay is unknown or unspecified, Nuexco's calculation of SWU quantity assumes 0.30 w/o tails assay.

[3] Price is not normalized to 0.30% tails assay.

[4] Refers to SWU Value that corresponds to SWUs included in transaction. When prices and SWU values are expressed as discounts (e.g., X dollars less than DOE's USEC base price at time of delivery), the percentage refers to the ratio of the *discounts*, not the ratio of the prices.

[5] The notation *R* means that Nuexco either does not know, or that Nuexco has restricted that information to protect client confidentiality.

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CURRENT MARKET DATA

URANIUM SUPPLY
(March 31, 1985)

	Delivery Period[1] (Thousands of Pounds U_3O_8)		
Nuexco Project Number	**Spot or Near-term[2]**	**Intermediate or Long-term**	**Remarks**
Available for Sale:			
ACTIVE			
1575	500	500 per year	
1860	400	1,500 per year	
2134	220	220 per year	1986-87
2389	200	—	
2392	35	—	UF_6
2538*	15	—	
2565	400	—	
2574*	640	—	
2584*	5	—	
2633	1,800	—	
2675	35	—	UF_6
2263	—	500 per year	1985-90
2625	—	250 per year	1987-89
2657	—	980	1986; UF_6
2680*	—	250 per year	1986-92
TOTAL:	4,250		
INACTIVE			
2191	125	—	UF_6
2275*	170	—	
2335	275	—	
2336	250	250 per year	1985-94
2495	130	—	UF_6
2553	300	—	
2654*	250	250 per year	UF_6
2271	—	500 per year	1985-88
2297	—	200 per year	1986-89
2368	—	250 per year	1987-90
2670	—	525	1987
TOTAL:	1,500		

* New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 0564, 2038, 2288A, 2288B, 2499, 2514, 2603, 2650.

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SWU SUPPLY
(January 31, 1985)

	Delivery Period[1] (Thousands of SWUs)		
Nuexco Project Number	Spot or Near-term[2]	Intermediate or Long-term	Remarks
Available for Sale:			
ACTIVE			
2100	150	100 per year	
2359*	—	200	
2583	50	—	
2624	100	—	
2631	150	—	
2632	25	—	
2689*	40	—	
2285	—	300	
2513	—	25	1986
2517	—	150	1986-89
2571*	—	55	1987
2657A*	—	175	1986
TOTAL:	515		
INACTIVE			
2164	25	—	
2589	50	—	
2378*	—	120	1988
2510*	—	50	
2531	—	150	1987
TOTAL:	75		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes SWUs deliverable within one year under other than spot or near-term contracts.
Projects removed since last month: None.

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CURRENT MARKET DATA

SWU DEMAND
(January 31, 1985)

	Delivery Period[1] (Thousands of SWUs)		
Nuexco Project Number	Spot or Near-term[2]	Intermediate or Long-term	Remarks
Inquiries to Purchase:			
ACTIVE			
2459	30	—	
2480	30	—	
2655	10	—	
2665*	50	—	
2519	—	30 per year	1987 on
2578	—	100	1986
2640*	—	40	1987
2653	—	100	1986-90
2658	—	5	1986
2689A*	—	40	1986
TOTAL:	120		
INACTIVE			
2543	25	25	1986
2585*	90	90	1986
2500	—	500	1987-90
2512	—	15 per year	1987 on
2595	—	50	1986
TOTAL:	115		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes SWUs deliverable within one year under other than spot or near-term contracts.
Projects removed since last month: 2443.

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PRIMARY MARKET CONVERTERS IN THE USA

The current uranium enrichment technology requires a gas as feed material, and commercial milling technologies produce natural uranium in solid form. Therefore, the enrichment process requires the conversion of solid uranium concentrates to a gas, uranium hexafluoride (UF_6). The conversion process is performed by five primary converters in the Western world. Because it represents only about three percent of fuel cycle costs (and less than one percent of electricity costs), the conversion process often is overlooked. UF_6 stockpiles at conversion plants and declining sales have caused converters to operate at substantially less than nameplate capacities. In today's buyers' market, the oversupply has not yet been counteracted by strong demand; in fact, the oversupply continues to grow. Although converters' inventories further complicate the true conversion supply situation, it is clear that there is already in place more conversion capacity than necessary for at least fifteen years. Nuexco forecasts indicate worldwide UF_6 consumption will be approximately 30,000 metric tons of uranium (MTU) in UF_6 in 1985, 40,000 MTU in 1990, and 45,000 MTU in 1995 (Table 1). On the other hand, current Western world conversion capacity already exceeds 50,000 MTU per year (Table 2).

Two companies in the USA provide conversion services for the world market. Allied Chemical, a division of Allied Corporation, converts uranium concentrates to UF_6 at its facility in Metropolis, Illinois. Sequoyah Fuels Corporation, a subsidiary of Kerr-McGee Corporation, converts natural uranium at its plant in Gore, Oklahoma.

Table 1

WORLD CONVERSION REQUIREMENTS FORECAST[1]

(Thousands MTU in UF_6)

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
United States	9.9	12.6	11.7	12.4	12.5	12.5	12.9	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6
Europe[2]	13.1	16.6	16.7	17.3	17.6	18.0	18.3	18.4	19.5	20.2	19.4	20.6	20.2	20.9	20.2
Far East[3]	4.3	6.1	6.2	6.4	7.1	7.5	7.3	8.6	8.9	8.6	9.5	9.8	10.3	10.7	10.0
Other Nations[4]	1.7	1.8	2.0	2.1	2.6	2.4	2.5	2.3	3.0	2.6	3.1	2.6	2.8	2.8	2.8
TOTAL[5] [6]	29.0	37.1	36.6	38.2	39.7	40.4	41.1	41.9	43.9	43.9	44.5	45.5	45.8	47.0	45.6

[1] Table ignores lead time for conversion. Consumption is based on computed quantities of U_3O_8 used to fabricate fuel for loading and reloading reactors operating, under construction, on order or forecasted as of November 15, 1984. Compiled and computed on a reactor-by-reactor basis; quantities for each reactor are based on specific core characteristics, 0.25% tails assay, no recycling, 24-month lead time for procuring first cores and 12-month lead time for procuring each reload. The estimates reflect annual consumption and not refueling quantities. First core fuel previously procured is not included.

[2] Austria, Belgium, Finland (two Swedish-supplied plants), France, Germany (FRG), Italy, Netherlands, Portugal, Spain, Sweden, Switzerland, United Kingdom, and Yugoslavia.

[3] China (PRC), Japan, Korea, Philippines, Taiwan.

[4] Argentina, Brazil, Canada, Egypt, India, Mexico, Pakistan, South Africa.

[5] Excludes Bulgaria, Cuba, Czechoslovakia, Germany (GDR), Finland (two USSR-supplied plants), Hungary, Poland, Rumania, and the USSR.

[6] Columns may not add, due to rounding.

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BASIC CONSIDERATIONS

The two companies provide conversion for most of the reactors in the USA, and for about forty percent of the reactors worldwide (Table 2).

Table 2

MARKET SHARES OF PRIMARY CONVERTERS[1]

Converter	Plant Location	Capacity (MTU/year)	Market Share (%) USA	Market Share (%) World
Allied Chemical	Metropolis, Illinois	12,700	45	20
Sequoyah Fuels	Gore, Oklahoma	9,000	40	21
Other Converters[2]	—	33,000	8	46
Uncovered or Unknown	—	—	7	13

[1] Based on the number of operational reactors (commercial or not) supplied by each converter.

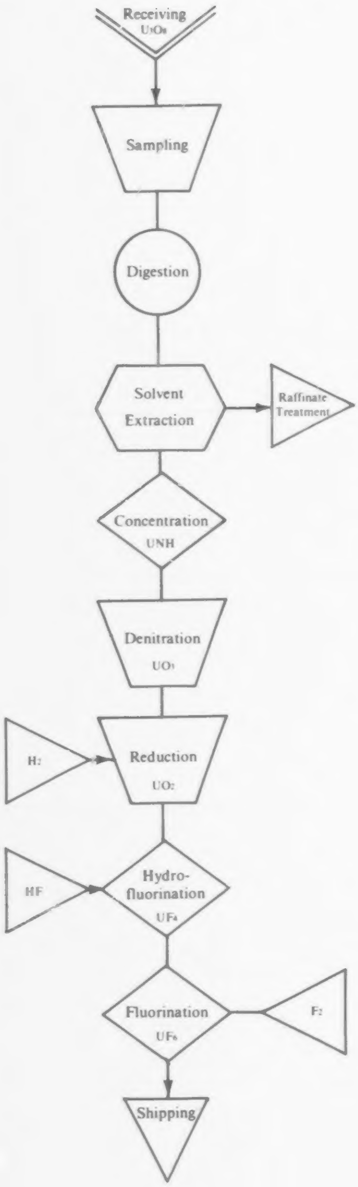
[2] BNFL (British Nuclear Fuels, Ltd.), Comurhex, Eldorado.

Allied began converting uranium concentrates at its plant in Metropolis, Illinois, in 1959. Using the dry fluoride volatility process, Allied currently has an annual capacity of 12,700 MTU, and has shipped over 150 million pounds of UF_6. The dry process is used to convert solid natural uranium concentrates only, the most common form. Sequoyah Fuels began operation in 1970 with an annual conversion capacity of 4,550 MTU. In 1978, Sequoyah expanded the facility, increasing its annual capacity to 9,000 MTU and introduced technology capable of processing slurry forms of uranium concentrates, which are becoming more prevalent due to the increasing use of alternative recovery methods. The conversion of slurry through the wet process eliminates the need for drying and packaging slurry at the milling site.

Sampling

Solid natural uranium concentrates (U_3O_8) are shipped by truck from a mill. Upon receipt, each 55-gallon drum is weighed, and the powder is dumped into an elevated hopper for sampling. Both Allied and Sequoyah Fuels retain an independent weighing and sampling firm, Lucius Pitkin, Inc. The concentrates are sampled for moisture content, uranium content and impurities, as well as overall weight.

Figure 1. Wet Conversion Process



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Pitkin utilizes the falling-stream method of sampling, in which several sample cutters remove ten percent of the material dumped in a falling stream from the feed batch. The process is repeated several times to insure a representative sample. Both the shipper and the receiver (converter) accept Pitkin's results on moisture content and weight. To verify uranium content and impurities, samples are sent to both producer and converter. If the parties agree to within 0.20 percent (Allied requires agreement to within 0.21 percent), the results are deemed acceptable. If they do not agree, the sample can be umpired, in which case the losing party pays for the independent umpiring.

At Sequoyah Fuels, uranium concentrates received in slurry form from solution mining usually arrive via tank trailer with approximately 4,000-gallon capacity. Nitric acid is added to the tank to dissolve the slurry, and the solution is pumped to a weigh tank for measurement and sampling.

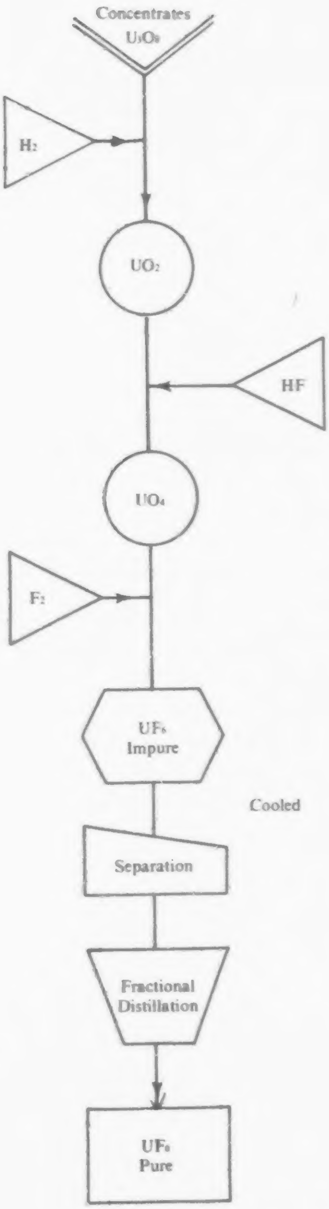
Conversion

In Sequoyah's wet process, conversion begins with the dissolution of uranium concentrates into uranyl nitrate using nitric acid (Figure 1). After the nitric acid digests the concentrates, the solution is similar to the slurry-nitric acid mixture found in the tank trailers (to which it often is added). Various solvent extraction methods follow, in which the uranyl nitrate is scrubbed of impurities. The uranium is separated from the acid solution by mixing with organic solvents and settling, leaving the impurities in the acid solution. This barren acid solution, or raffinate, is removed and the purified uranyl nitrate is re-extracted into water. A concentration step follows, in which evaporation concentrates the weak uranyl nitrate solution into molten uranyl nitrate hexahydrate (UNH), an intermediate which subsequently undergoes denitration (the removal of the nitrate through thermal decomposition) to form uranium trioxide (UO_3).

The next steps involve the reduction and fluorination of the UO_3 powder. Hydrogen is introduced, capturing oxygen to form UO_2 and water (H_2O). The UO_2 powder then reacts with hydrofluoric acid (HF) to become UF_4, known as green salt. Finally, the UF_4 reacts with elemental fluorine to form UF_6. Allied and Sequoyah Fuels manufacture their own fluorine; Sequoyah produces fluorine gas by electrolysis at the conversion site, while Allied operates a commercial hydrofluoric acid (HF) plant in Geismar, Louisiana.

Sequoyah Fuels processes slurry by adding nitric acid to the slurry in the tank trailer for digestion, and pumping

Figure 2. Dry Conversion Process



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the solution into weigh tanks for measurement. Liquid samples are taken, and the solution joins the separation system.

Allied's dry process differs from wet processing in several ways. The first step consists of the direct fluorination of the U_3O_8 concentrates (Figure 2). Hydrofluoric acid reacts with the uranium oxides or ammonium diuranate (ADU), and the impure UF_6 undergoes a series of purification steps. Problems in the dry process can arise when magnesium or sodium uranates are used; the HF reaction forms sticky products which can adhere to the reactor walls at the conversion facility. No significant differences in quality of UF_6 have been found between the two conversion processes, although the wet process contains the flexibility to convert slurries and other non-solid forms of feed material.

Following conversion, the UF_6 gas enters cold traps designed to liquify the gas so it can be drained into shipping cylinders. As the cylinders cool to room temperature, the UF_6 solidifies. Because of the tremendous weight of the solid UF_6, a truck can transport only two ten-ton (6,400 Kg) cylinders at a time. Fourteen-ton (8,400 Kg) cylinders often are used when shipping overseas. The cylinders are then ready for shipment to one of DOE's enrichment plants, or, in some cases, to an overseas enrichment plant.

Conversion Supply and Demand

It is difficult to determine true world supply figures for conversion. Most of the facilities in operation today currently operate well below full nameplate capacity because of the industry's oversupply situation. The flow of uranium concentrates into conversion facilities remains greater than the flow of UF_6 to enrichment plants, resulting in the buildup of large stockpiles at the conversion sites. Moreover, the rate at which the converter processes material is subject to a number of variables, including the efficiency of the electrolytic elemental fluorine plant.

Similarly, conversion demand can be influenced by many variables. A higher enrichment tails assay would result in increased uranium demand, proportionately increasing the need for UF_6. Reprocessing, with respect to both uranium recycling and plutonium, would reduce significantly the demand for natural uranium, but commercial applications are a long-term consideration and should not affect conversion demand in this century. These uncertainties pose only minor problems for converters when planning for expansion or a new facility, the construction of which requires a lead time of approximately five years.

In March 1985, DOE will announce its intentions for the future of uranium enrichment in the USA. One of the new technologies under consideration, Atomic Vapor Laser Isotope Separation (AVLIS), is a method of drawing off the U_{235} isotope by laser excitement. This process uses uranium metal as feed material for enrichment, instead of UF_6. Should DOE decide to proceed with AVLIS as its enrichment technology of the future, the conversion industry in the USA would be forced to adapt accordingly.

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AUSTRALIA

In view of the current state of the uranium market, the announcement by Energy Resources of Australia, Ltd. (ERA) of two long-term supply contracts with US utilities was both surprising and revealing. The agreement with American Electric Power (AEP) is actually a renegotiation of the original AEP-Ranger agreement under which deliveries had been suspended because market prices had fallen well below the Australian floor price. The second agreement is with Pennsylvania Power & Light.

Notwithstanding the press response to the ERA announcement, it is most unlikely that US utilities would agree to terms that could require them to buy large amounts of uranium at prices substantially higher than spot market prices. Accordingly, it is probable that these agreements are, in effect, *call* options that allow considerable delivery flexibility and provide that if, as, and when market prices exceed the Australian floor price, the utilities may call on ERA for delivery at discounts from market price. Alternately, the contracts could be structured as *put* options, giving ERA the right to deliver to the utilities at prices below market whenever certain contract terms are met, such as market price exceeding the Australian floor price for a specified period. In either case, the contracts probably do not require the utilities to take and pay for any meaningful quantities while market price is below the Australian floor.

Perhaps the greatest significance of these contracts is the continuing, subtle maneuvering for position between ERA and the Olympic Dam project (Roxby Downs). As ERA adds customers, Olympic Dam's roster of potential customers is reduced accordingly. If the present floor price is maintained (or raised), neither ERA nor Olympic Dam would be able to export under market price contracts until market prices rise sharply or the floor price is reduced. In either case, ERA's ability to increase capacity rapidly and at lower cost per unit seems to give it a considerable advantage over Olympic Dam, which has to base load, finance, and construct an entirely new facility.

However, the Olympic Dam partners, Western Mining and British Petroleum, have their own unique situation. Preliminary marketing is under way, and with copper and gold as co-products, usual financing requirements may be alleviated. This would allow uranium production to begin at levels that might be sub-economic in a stand-alone uranium operation. Finally, the Olympic Dam project presents the prospect of supply diversity within Australia combined with very large, long-term reserves backed by financially responsible ownership.

* * *

Western Mining Corporation (WMC) and BP Australia, the joint venture partners in the Olympic Dam project (Roxby Downs), have commissioned Fluor Corporation to carry out a technical study. The study will be completed in March 1985 and is part of the A$150 million feasibility study now in progress. Because market demands for the planned copper and uranium production are limited, the project will be designed to reach full production in stages. The first stage will be designed to treat high-grade ore averaging three percent copper, 3.3 pounds U_3O_8 and 0.4 grams of gold per ton of ore. Annual yield would be 2,000 metric tons of U_3O_8 and 55,000 metric tons of copper starting in 1988. Gold production could begin earlier at a rate of 100,000 ounces per year. Part of the study will review the work done to date, but it also signals the further acceleration of the project by WMC and BP toward their goal of beginning production in the late 1980s.

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RECENT DEVELOPMENTS

SOUTH AFRICA

Fourth quarter production from Chamber of Mines producers amounted to approximately 3.4 million pounds U_3O_8, down slightly (4 percent) from the 3.5 million pounds produced in the third quarter, and the average of 3.7 million pounds produced in the first three quarters of 1984. Most of this decline can be attributed to the following factors:

1. An 85-percent drop in production at Beisa (St. Helena) following the cessation of mining operations and the completion of underground reclamation;
2. A 40-percent decline in production at Blyvooruitzicht due to the slowing of operations following a decision to cease production by 1985;
3. A 31-percent decline at Driefontein Consolidated because of lower grades and a reduction of throughput in the closing months of 1984.

These losses were partially offset by a 37-percent production increase at JMS (Free State Joint Metallurgical Scheme), and a 10-percent increase at Buffelsfontein.

* * *

Total production in 1984 of 14,531,000 pounds U_3O_8 was five percent less than 1983 (Table 3). Eight producers experienced declines in production totalling approximately 1.2 million pounds, over 60 percent of which was attributed to Harmony, Beisa, and JMS (notwithstanding its fourth-quarter production increase). This decline was partially offset by increases in production by three producers amounting to approximately 450 thousand pounds. Randfontein and Vaal Reefs contributed 90 percent of the increase.

South Africa's gold and uranium industries experienced a relatively prosperous year despite lower US dollar prices for gold (Table 4). South Africa's contracts customarily are denominated in US dollars. Although most South African uranium sales involve long-term contracts in which spot prices do not play a crucial role, examining the relationship between the Exchange Value expressed in dollars and that expressed in rands can give an indication of the currency exchange rate's effect on long-term uranium prices. The Exchange Value declined 31 percent in dollar terms during 1984, but the 61-percent increase in the currency exchange rate caused the Exchange Value to rise 12 percent in rand terms. Moreover, because the prices South African producers received under long-term contracts did not decline in dollar terms nearly as much as did the Exchange Value, South Africa's long-term prices increased in rand terms even more than the 12 percent by which the Exchange Value increased. The severe depreciation of the rand in relation to the dollar also resulted in record rand gold prices. Since by-product and co-product uranium production from gold mining in general costs less than primary uranium production, the gold/uranium operations strongly contributed to the viability of the uranium industry in South Africa.

Palabora Mining Company (PMC) announced in its annual report to shareholders that it sold 502 thousand pounds of uranium concentrates in 1984. This represents a 2[illegible]-percent increase from the 356 thousand pounds sold in 1983. PMC, which is not a member of the Chamber of Mines, produces uranium as a by-product of its copper-mining operations.

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Table 3

REPUBLIC OF SOUTH AFRICA: 1984 URANIUM PRODUCTION[1]

(Thousands of pounds U_3O_8)

Operation	First Quarter 1984	Second Quarter 1984	Third Quarter 1984	Fourth Quarter 1984	Total 1984 Production
Beisa (St. Helena)[2]	338	333	107	16	794
Blyvooruitzicht	155	132	142	85	514
Buffelsfontein	313	331	337	371	1,352
Chemwes (Stilfontein)	310	279	290	276	1,155
Driefontein Consolidated	98	104	88	61	351
ERGO[3]	113	94	71	84	362
Harmony	307	259	274	255	1,095
Hartebeestfontein	248	253	225	237	963
JMS[4]	356	265	293	402	1,316
Randfontein	287	361	361	297	1,306
Vaal Reefs	1,069	1,129	1,078	1,052	4,328
Western Areas	175	171	164	163	673
Western Deep Levels	79	82	83	78	322
TOTAL	3,848	3,793	3,513	3,377	14,531

[1] Excludes Palabora Mining Company, which is not a member of the Chamber of Mines.

[2] Mining operations ceased and underground reclamation completed.

[3] ERGO = East Rand Gold and Uranium Co. Ltd.

[4] JMS = Free State Joint Metallurgical Scheme.

Table 4

URANIUM AND GOLD PRICES

Date	Nuexco Exchange Value (per lb. U_3O_8)	Percent Change	Gold Price (per ounce)	Percent Change	Exchange Rate (rand/dollar)	Percent Change
December 30, 1983					1.2182	
US Dollars	22.00		381.50			
SA Rand	26.80		464.74			
December 31, 1984					1.9666	+61
US Dollars	15.25	-31	309.00	-19		
SA Rand	29.99	+12	607.68	+31		

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RECENT DEVELOPMENTS

UNITED STATES

DOE announced that it has negotiated a concession from Tennessee Valley Authority (TVA) over the price of electricity purchased for use at two of DOE's uranium enrichment plants, in Paducah, Kentucky and Oak Ridge, Tennessee. Under the agreement, TVA would offer to supply low-cost electricity, called Experimental Test Energy (ETE), during TVA's non-peak hours, and would determine in advance the amount of ETE to be available. This follows Duke Power Company's 1984 offer to sell electricity to DOE at 18 mills/megawatt-hour (MWh), which failed when TVA refused to wheel the power to the enrichment plants.

DOE, in presentations to news media, publicized a 20-percent discount. However, it is clear that the actual savings will finally amount to less than one dollar per SWU. Various reports estimate the discount to be from 37 cents off the base cost per SWU to a 68-cent-per-SWU discount. The following pro forma analysis demonstrates the reasoning by which the estimated savings may be calculated.

Table 5 indicates DOE's approximate power costs before the announcement of the potential TVA agreement.

Given that DOE pays 25 mills per kilowatt-hour for firm energy (without the new discount), Table 5 can be used to estimate that DOE could buy a maximum of about 4,500 megawatts of electricity (MWe) from TVA in a given year. If DOE took less, it still would pay about 11 mills per MWe not taken.

The TVA discount for ETE could apply on weekends, holidays, and from 10 p.m. to 6 a.m. on weekdays. In the following calculations, it is assumed that the discount would be applied 40 percent of the time. The average TVA price for firm energy then becomes 23 mills per kilowatt-hour. If DOE continues to take 500 MWe per year from TVA, the average TVA price with the new discount will be:

$$\frac{11\ (4{,}500 - 500) + 23\ (500)}{500}$$

$$= 111 \text{ mills per KWh}$$

The overall price averaged over all suppliers will be:

$$\frac{(500 \times 111) + (1{,}380 \times 18.5) + (735 \times 23.6)}{2{,}615}$$

$$= 37.6 \text{ mills per KWh}$$

This represents an actual power cost reduction of one percent over the current cost of 38.0 mills per KWh, provided DOE does not redistribute their energy demand.

Assuming that 50 percent of the DOE SWU price to utilities is ascribed to energy costs, the TVA discount could yield a SWU price reduction of 0.5 percent, or 68 cents, if such a discount were fully passed on to the customers. Other assumptions would yield different numbers, but the reasoning would remain the same.

Table 5

DOE POWER COSTS

	Before July 1984		July 1984 to Oct. 1984		After Oct. 1984	
Source	Amount Purchased (MW/yr)	Unit Cost (mil/KWh)	Amount Purchased (MW/yr)	Unit Cost (mil/KWh)	Amount Purchased (MW/yr)	Unit Cost (mil/KWh)
TVA	1,140	57.3[1]	650	91.1[1]	500	113.2[1]
OVEC[2]	1,260	17.9	1,260	17.9	1,380	18.5
EEI[3]	735	22.1	735	22.1	735	23.6
Total (Average)	3,135	(33.2)	2,645	(37.1)	2,615	(38.0)[4]

[1] Includes charge for power not taken.
[2] OVEC = Ohio Valley Electric Corp.
[3] EEI = Electric Energy Inc.
[4] Represents a 14.5-percent increase over the pre-July price.

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1984 US URANIUM ACTIVITIES

Introduction

Uranium exploration and mining activities decreased steadily throughout 1984 as the market for uranium concentrates continued the downward trend that began during the last quarter of 1983. Reduced competition for limited sales opportunities created a brief respite in the price decline, holding the Nuexco Exchange Value at $17.50 per pound U_3O_8 during the period June through September. However, as sellers adjusted to renewed market pressure, even lower prices prevailed. By year end, the Nuexco Exchange Value had reached $15.25, its lowest level since January 1975.

US uranium production for 1984 is estimated by Nuexco at about 15.4 million pounds, down from 21.2 million pounds in 1983. Solution mining in the South Texas district and phosphoric acid production in Florida and Louisiana accounted for almost 35 percent of the 1984 output. Conventional production centers continued to curtail activities during the year. Three milling operations closed down for six or more months, and several other projects were put on temporary stand-by, announcing intent to resume operations as the market recovers.

Exploration and development drilling activity declined as expected based on an active rig count. Nuexco estimates total drilling at 2.0 to 2.5 million feet as compared to DOE's estimate of 3.5 million feet for 1983. (*Note:* DOE no longer collects drilling and ore reserve information related to the uranium resource industry.) Nuexco's estimate is based on information supplied by a survey of selected companies.

Exploration drilling by at least six companies in the South Texas district averaged seven working rigs per month throughout the year; development drilling averaged six rigs per month.[1] Throughout Arizona, Colorado, Nebraska, New Mexico, Utah and Wyoming, at least 13 companies participated in drilling, with an average monthly rig count of 14 for exploration drilling and seven for development drilling. In the Grants, New Mexico district, for many years the most active district in the USA, there was no exploration drilling for eight months of the year, but one to four companies drilled during August to fulfill annual property requirements; development drilling was limited to nine months with one to three rigs.

Active Projects

Exploration activity in the South Texas district continued along known geologically favorable trends located primarily in Duval, Brooks and Kleberg counties. The favored targets were fine to coarse sand and conglomerate units of the Goliad Formation. Further north in Live Oak and Bee counties, the main target remains the Oakville Sandstone. There were no significant discoveries announced in 1984; however, development drilling in certain areas proved successful in delineating additional reserves and enhancing certain active solution-mining operations.

The area north and south of Grand Canyon National Park experienced a slight surge in activity. Five or six major uranium companies continued to acquire new ground for exploration, including geophysical and drilling programs. The exploration target is potentially high-grade deposits in breccia pipe structures common to the district. In addition, another eight to ten small exploration companies and independent operators competed for the more favorable exploration targets. Constructive exploration was limited primarily to annual work requirements related to conditions of property acquisition.

Energy Fuels Ltd. (EFL) remains the most aggressive and successful operator in the district. EFL presently is mining three highly mineralized breccia pipe deposits and is developing a fourth scheduled for production sometime in late 1987 or early 1988. In addition, EFL has applied to federal and state agencies with the intent of developing yet another deposit. The proposed project site is the Canyon pipe located on the south side of the Grand Canyon. If the project proceeds, it will be the first uranium mining in the southern rim district since the Orphan pipe was last mined in 1969.

Ferret Exploration Company continued to explore its Big Red property in Dawes and Box Butte counties of Nebraska. The mineral trend at the large Crow Butte deposit has been traced for several miles south onto the Big Red property. Ferret remains optimistic about property potential as a result of the important uranium resources identified to date.

Development of the Crow Butte project (owned 50 percent by Wyoming Fuel Company and 50 percent by Ferret) has been delayed by the permitting process. The joint venture anticipates licensing and permitting requirements will be in place in early 1985 and construction of a solution-mine pilot plant should begin by mid-to-late 1985.

Everest Minerals Corp. is continuing project feasibility studies on its Highland property located in South Powder River Basin, Wyoming. Everest has announced its intent to develop a solution mine on the property, probably during the second half of 1986. The ore deposit is a down-dip westward extension of Exxon's open pit, which closed in March 1984.

Events that further affected the US uranium industry in 1984 are listed chronologically in Table 6.

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[1] It should be noted that by Nuexco estimate, drilling time per rig varies from 1 to 23 days per month and may average less than 10 working days per rig; thus, footage drilled was held below normal capabilities.

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RAW MATERIALS

Table 6

1984 URANIUM-RELATED ACTIVITIES IN THE USA

Month	Organization	Event or Announcement
Jan	Union Carbide Corp.	Reached agreement with Energy Fuels for operatorship and 70% of production capacity at the Energy Fuels Mill at White Mesa, Utah.
Jan	Western Nuclear, Inc.	Announced plan to reopen the mine at Ruby Wells, New Mexico.
Feb	Atlas Corp.	Closed the Velvet, Pandora and Rim mines. Announced plans to close the Moab mill; 200 employees affected.
Feb	US DOE	Estimated 1983 production at 21.2 million pounds compared to 26.9 million in 1982.
Feb	United Nuclear Co.	Ended negotiations to purchase Ogle uranium properties in Wyoming.
Mar	Reserve Oil & Minerals Corp.	Agreed to sell its Canadian uranium interests.
Mar	Pathfinder Mines Corp.	Closed its underground mining operations off the pit walls of the Lucky Mc mine, Gas Hills, Wyoming.
Mar	American Nuclear Corp.	Agreed in principle with TVA to end joint venture on properties in Wyoming.
Mar	Exxon Nuclear Co.	Closed its Highland open-pit mine, Powder River Basin, Wyoming.
Mar	Ranchers Corp.	Announced plans to merge with Hecla Mining Co.
April	Caithness Corp.	Began restoration at the McBryde solution mine, Hebbronville, Texas.
April	Tenneco Minerals Co.	Suspended production at West Cole solution mine, Hebbronville, Texas.
April	Union Carbide Corp.	All mineral resources to operate under new subsidiary—UMETCO Minerals Corp.
April	Plateau Resources Ltd.	Closed its mine at Shootaring Canyon, Utah.
June	Quivira Mining Co.	Laid off 276 employees in 40% cutback of mine and mill operations.
June	Exxon Nuclear Co.	Closed its Highland mill, Powder River Basin, Wyoming.
July	Western Nuclear, Inc.	Will reopen the Ruby Wells mine, recalling 70 employees.
July	Union Carbide Corp.	Announced intent to put all mining projects on standby during fourth quarter.
Aug	Western Nuclear, Inc.	Closed its Sherwood, Washington mine and mill.
Aug	Tennessee Valley Authority	Announced offer to sell open pit properties, Gas Hills, Wyoming.
Sept	Homestake Mining Co.	Placed its Grants, New Mexico mill on standby; 60 employees affected.
Oct	Union Carbide Corp.	Closed mills at Uravan, Colorado and Gas Hills, Wyoming. 30 employees laid off.
Nov	Federal Trade Commission	FTC approved merger plan for Chevron Corp. and Gulf Corp. Chevron will control the Mt. Taylor deposit, Grants, New Mexico.

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Table 6

1984 URANIUM-RELATED ACTIVITIES IN THE USA *(continued)*

Month	Organization	Event or Announcement
Nov	Homestake Mining Co.	Broke off negotiations with Midas, Inc., for participation in mine development at Grants, New Mexico.
Dec	American Nuclear Corp.	Reached final agreement with TVA to settle joint venture relationship in relation to properties in the Gas Hills and Powder River Basin, Wyoming.
Dec	Energy Fuels Nuclear, Inc.	Applied for permits to develop breccia pipe deposit on south side of the Grand Canyon, Arizona.
Dec	Union Carbide Corp.	Suspended uranium exploration affecting 50 employees; announced intent to stop all mining projects by March, 1985.
Dec	Pathfinder Mines Corp.	Will spend $4 million to modernize the Lucky Mc mill, Gas Hills, Wyoming.
Dec	Homestake Mining Co.	Recalled 20 employees in preparation of mill startup in early January.

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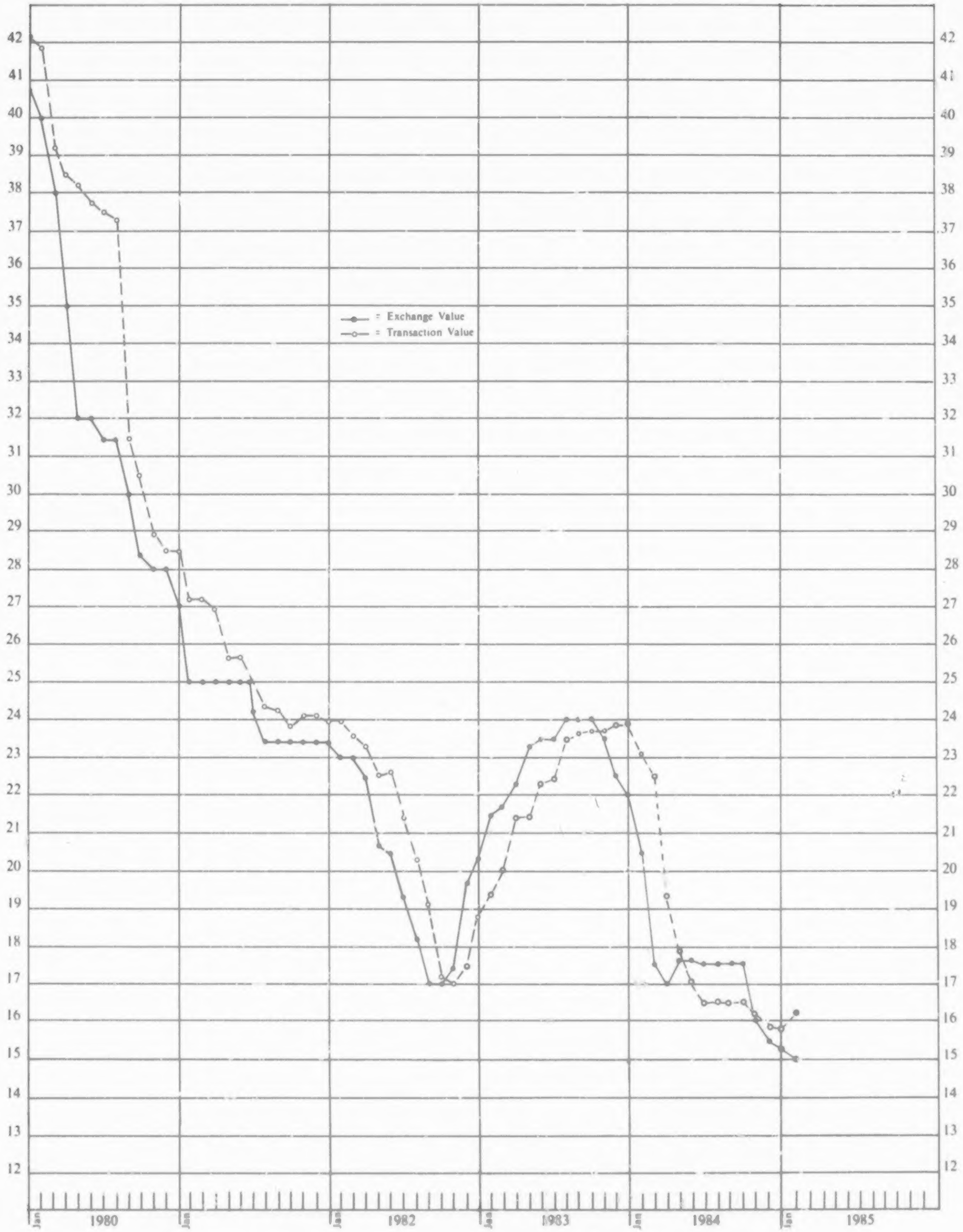
HISTORICAL MARKET DATA

EXCHANGE AND TRANSACTION VALUES SINCE JANUARY 1980

Determined as of the last day of the month indicated



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FEBRUARY 1985 NUMBER 198

MONTHLY REPORT

ON THE NUCLEAR FUEL MARKET

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MONTHLY REPORT ON THE NUCLEAR FUEL MARKET
February 1985 No. 198

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To Our Readers

Nuexco announces the election of George White, Jr. as Chairman of the Board of Directors replacing Bob Wolcott, who resigned.

From its founding in 1968, Nuexco has benefited from sound leadership. Founders George White, Sr. and A. Payne Kibbe were innovators and builders, taking an idea and turning it into reality. During the past eight years, Bob Wolcott's vision developed Nuexco into an international, full-service nuclear fuel organization. Bob's contribution was enormous and enduring.

The new management looks forward to continuing this record of excellence.

* * *

Nuexco will host a hospitality suite during the Atomic Industrial Forum's Fuel Cycle Conference in New Orleans, Louisiana, March 12–15, at the Hyatt Regency. We look forward to seeing you there.

* * *

Nuexco's US offices will be closed on Monday, February 18 in honor of George Washington and Abraham Lincoln's birthdays. Our European office will be open for business as usual.

* * *

Included in this Report is a map to our offices in Stamford, Connecticut. We welcome customer visits.

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NATURAL URANIUM AND SECONDARY MARKET CONVERSION

The **Exchange Value** as of January 31, 1985 is **$15.00** per pound U_3O_8, down $0.25 since last month. **Active supply** of natural uranium (U_3O_8 and UF_6) for spot or near-term delivery totals **4,180,000** pounds U_3O_8 or equivalent UF_6, up 540,000 pounds since last month. The corresponding figure for **active demand** is **1,265,000** pounds, up 15,000 pounds. The spot and near-term **supply-demand ratio** rose to **3.3:1.**

The *Current Market Data* section of this Report lists two uranium sales transactions, involving a total of approximately 500,000 pounds equivalent U_3O_8. One of the transactions reported this month involved low-enriched uranium, both involved deliveries before 1986, and one met the criteria for inclusion in the current Transaction Value calculation.

The **Transaction Value** as of January 31, 1985 is **$16.20** per pound U_3O_8, up $0.30 since last month. The current Transaction Value includes 14 transactions involving a total of 2.1 million pounds U_3O_8 or equivalent UF_6 and covers a period of 7 months. The Transaction Value rose as a result of dropping from the calculation June data, which included a transaction for a large quantity at a low price.

The **Loan Use Charge Rate** as of January 31, 1985 is **6 percent** per annum, unchanged since last month in a dormant market.

* * *

The Exchange Value declined for the fourth month in a row as the market for natural uranium concentrates continued to weaken. At $15.00, it has reached its lowest level since December 31, 1974. Buyers continue to hold out for the best possible terms, keeping market activity at a minimum and applying significant downward pressure on the Exchange Value. The buyer and seller indifference level, or that price range in which transactions may be completed between buyers that are willing but not pressured to buy and sellers that are willing but not forced to sell, has widened over the past several months. However, Nuexco has seen some indications of late that the gap might be narrowing; some buyers seem to be preparing to act as though they believe the market is approaching a low price plateau.

Several offers hovered below the $15.00 level, but certain contingencies applied which rendered them unfeasible. One seller chose not to sell immediately, and other opportunities involved quantities too small to be deemed significant. The typical quantity desired by buyers is something approximately equal to one reload. Quantities less than that need to be discounted substantially to overcome the buyers' reluctance to piece together several small lots to acquire the desired quantity. Substantial quantities of material remain available, both as UF_6 and as concentrates, so downward pressure on market prices continues.

* * *

The **Conversion Value** is **$1.00** per pound U in UF_6, up $0.20 since last month. One secondary market conversion transaction is reported, involving approximately 500,000 pounds U in UF_6. Active supply of secondary market conversion services for delivery within three years disappeared as the lone supplier withdrew from the market. Furthermore, one potential buyer for a large quantity has given indications of willingness to pay approximately $1.00 per pound U as UF_6 for conversion services on the secondary market. Active secondary market demand for conversion amounts to 760,000 pounds U in UF_6.

ENRICHED URANIUM AND SWUS

The Nuexco **SWU Values** as of January 31, 1985 are:

1. For **DOE origin,** a tails assay of 0.30 weight-percent U_{235}, and certifiable as excess:
    a. For FY85 delivery, $112 per SWU, unchanged;
    b. For FY86 delivery, $15 discount from the USEC base price on delivery, unchanged;
2. For **other** SWUs (includes DOE origin SWUs not certifiable as excess and non-DOE origin SWUs):
    a. For delivery in calendar year 1985, $80 per SWU, unchanged;
    b. For delivery in calendar year 1986, $90 per SWU, unchanged.

Two secondary market SWU transactions are reported, involving approximately 100,000 SWUs. One of the transactions involved low-enriched uranium.

* * *

SWU Values were unchanged this month as the lack of activity precluded a noticeable change in market prices. The market for DOE SWUs and FY85 delivery should remain open but inactive through February, until DOE announces new FY86 prices. Activity in the FY85 market has been very slow, and only a few sellers are still active. One new buyer, possibly the last FY85 SWU buyer, entered the market in January. The number of buyers interested in DOE SWUs for FY86 delivery is increasing, and they are preparing to enter the market following the DOE announcement. The timing for secondary market purchases is awkward now, because the absence of firm DOE prices for FY86 SWU makes economic comparisons difficult.

The market for SWUs other than DOE certifiable is almost dormant. Most utilities have filled all requirements until 1987, at which point the USEC allows many to fulfill 30 percent of requirements. Consequently, demand in Europe and the USA is very low. European buyers, however, are beginning to show more interest in long-term SWU purchases, most for 1987 and beyond.

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CURRENT MARKET DATA

January 31, 1985	Market Values	Active Supply[1] (thousands)	Active Demand[1] (thousands)
EXCHANGE VALUE	**$15.00**/lb. U_3O_8	4,180	1,265
CONVERSION VALUE	**$1.00**/lb. U in UF_6	0	760
SWU VALUES			
DOE origin, certifiable as excess, 0.3 tails assay			
FY85 delivery	**$112**/SWU		
FY86 delivery	**$15** discount/SWU		
Other SWUs (non-DOE or non-certifiable)			
calendar year 1985 delivery	**$80**/SWU		
calendar year 1986 delivery	**$90**/SWU		
LOAN USE CHARGE RATE	**6%**/annum	0	0

TRANSACTION VALUE	$/lb. U_3O_8	Millions of Pounds	Number of Transactions	Number of Months
	15.20/	2.1	14	7

[1] Supply and demand tables in the *Current Market Data* section of this Report detail the numbers for each category.

DEFINITIONS

1. The **Exchange Value** is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the date indicated.
2. The **Conversion Value** is Nuexco's judgment of the price at which spot and near-term transactions for significant quantities of conversion services could be concluded in the secondary market as of the date indicated.
3. The **SWU Values** represent Nuexco's judgment of the price at which transactions for the sale of significant quantities of SWUs of stated origin for delivery in the specified time period could be concluded as of the date indicated.
4. The **Loan Use Charge Rate** is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the date indicated.
5. The **Transaction Value** is a weighted average price of recent natural uranium sales transactions. The calculation is based on prices paid in:
   a. Transactions closed within the previous three-month period for which delivery is scheduled within one year of the transaction date;
   b. At least ten transactions;
   c. Transactions involving a sum total of at least 2 million pounds U_3O_8 equivalent.

The sample time is extended as necessary to include these minima. Other currencies are converted to US dollars using conversion rates in effect on or near the transaction date.

DERIVATIONS AND COMMENTS

1. All Market Values are based on:
   a. Data from recently completed transactions.
   b. Data from pending transactions.
   c. Firm bids to buy or borrow, and firm offers to sell or lend.
   d. Prices purchasers or rates borrowers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy or borrow, and prices sellers or rates lenders have expressed a willingness to offer, but for which Nuexco is not aware of firm offers to sell or lend.
2. Prices associated with deliveries under old or renegotiated contracts or other than arm's-length transactions are not considered in the determination of these Market Values.
3. In the determination of the Conversion Value, Nuexco does not consider transportation charges other than those customarily provided by primary suppliers of conversion services.
4. The prices of conversion services or SWUs delivered under long-term contracts with primary suppliers are not considered in the determination of either the Conversion Value or SWU Value.
5. For the DOE SWU Values, Nuexco converts SWU prices at varying tails and product assays to equivalent SWU prices at a tails assay of 0.30 weight-percent U_{235} and a product assay of 3.0 weight-percent U_{235}, assuming feed costs corresponding to the Nuexco Exchange and Conversion Values determined as of the same date.
6. In calculating the Transaction Value, Nuexco does not account for the price of uranium delivered in connection with contracts which call for "market price" mechanisms. This exclusion applies particularly to contracts in which delivery prices are expressed as a function of future Exchange Values or any other indeterminant variable. Also excluded from the calculation are any other transactions in which the delivery price is defined in such a way that it cannot currently be determined.

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CURRENT MARKET DATA

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb. U_3O_8 in Concentrates This Month (Jan. 31, 1985)	Last Month (Dec. 31, 1984)	12 Months Ago (Jan. 31, 1984)	per kg. U in Concentrates This Month (Jan. 31, 1985)	Last Month (Dec. 31, 1984)	12 Months Ago (Jan. 31, 1984)
Australia (dollar)	18.38	18.37	22.33	47.78	47.77	58.06
Belgium (comm. franc)	949.37	960.33	1,177	2,468	2,497	3,061
Canada (dollar)	19.91	20.13	25.60	51.77	52.34	66.54
Finland (markka)	99.40	99.48	121.81	258.43	258.62	316.67
France (franc)	145.07	147.20	176.42	377.14	382.69	458.65
FRG (mark)	47.53	47.99	57.65	123.56	124.75	149.87
Italy (lira)	29,240	29,480	35,121	76,017	76,641	91,306
Japan (yen)	3,817	3,814	4,809	9,923	9,917	12,502
Netherlands (guilder)	53.74	54.08	64.83	139.72	140.59	168.55
South Africa (rand)	29.56	29.99	25.98	76.84	77.97	67.55
Spain (peseta)	2,628	2,638	3,250	6,832	6,857	8,450
Sweden (krona)	135.62	136.53	167.76	352.59	354.94	436.13
Switzerland (franc)	40.11	39.54	45.97	104.27	102.79	119.52
UK (pound)	13.27	13.10	14.56	34.50	34.05	37.87
US (dollar)	15.00	15.25	20.50	39.00	39.65	53.30

TRANSACTION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb. U_3O_8 in Concentrates This Month (Jan. 31, 1985)	Last Month (Dec. 31, 1984)	12 Months Ago (Jan. 31, 1984)	per kg. U in Concentrates This Month (Jan. 31, 1985)	Last Month (Dec. 31, 1984)	12 Months Ago (Jan. 31, 1984)
Australia (dollar)	19.85	19.16	25.11	51.60	49.80	65.28
Belgium (comm. franc)	1,025	1,001	1,324	2,666	2,603	3,442
Canada (dollar)	21.51	20.99	28.78	55.91	54.57	74.82
Finland (markka)	107.36	103.72	136.96	279.10	269.64	356.06
France (franc)	156.67	153.47	198.36	407.31	399.00	515.70
FRG (mark)	51.33	50.03	64.82	133.45	130.07	168.52
Italy (lira)	31,579	30,737	39,489	82,098	79,908	102,664
Japan (yen)	4,122	3,977	5,407	10,717	10,339	14,057
Netherlands (guilder)	58.04	56.38	72.90	150.90	146.58	189.52
South Africa (rand)	31.92	31.27	29.21	82.99	81.29	75.95
Spain (peseta)	2,838	2,750	3,655	7,378	7,149	9,501
Sweden (krona)	146.47	142.35	188.63	380.80	370.07	490.38
Switzerland (franc)	43.32	41.22	51.69	112.61	107.17	134.39
UK (pound)	14.33	13.65	16.38	37.25	35.50	42.58
US (dollar)	16.20	15.90	23.05	42.12	41.34	59.92

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[1] Calculated using currency exchange rates published in the *Wall Street Journal* on January 31, 1985.

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CURRENT MARKET DATA

CONVERSION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

	per lb. U as UF_6			per kg. U as UF_6		
Country (currency)	**This Month (Jan. 31, 1985)**	**Last Month (Dec. 31, 1984)**	**12 Months Ago (Jan. 31, 1984)**	**This Month (Jan. 31, 1985)**	**Last Month (Dec. 31, 1984)**	**12 Months Ago (Jan. 31, 1984)**
Australia (dollar)	1.23	0.96	0.65	2.70	2.13	1.44
Belgium (comm. franc)	63.29	50.38	34.46	139.53	111.06	75.98
Canada (dollar)	1.33	1.06	0.75	2.93	2.33	1.65
Finland (markka)	6.63	5.22	3.57	14.61	11.50	7.86
France (franc)	9.67	7.72	5.16	21.32	17.02	11.38
FRG (mark)	3.17	2.52	1.69	6.99	5.55	3.72
Italy (lira)	1,949	1,546	1,028	4,298	3,409	2,266
Japan (yen)	254.45	200.10	140.75	560.97	441.14	310.29
Netherlands (guilder)	3.58	2.84	1.90	7.90	6.25	4.18
South Africa (rand)	1.97	1.57	0.76	4.34	3.47	1.68
Spain (peseta)	175.19	138.36	95.13	386.23	305.03	209.73
Sweden (krona)	9.04	7.16	4.91	19.93	15.79	10.82
Switzerland (franc)	2.67	2.07	1.35	5.89	4.57	2.97
UK (pound)	0.88	0.69	0.43	1.95	1.51	0.94
US (dollar)	1.00	0.80	0.60	2.20	1.76	1.32

SWU VALUES EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	DOE SWU FY85 (January 31, 1985)	Non-DOE SWU 1985 delivery (January 31, 1985)	Non-DOE SWU 1986 delivery (January 31, 1985)
Australia (dollar)	137.22	98.02	110.27
Belgium (comm. franc)	7,089	5,063	5,696
Canada (dollar)	148.68	106.20	119.47
Finland (markka)	742.21	530.15	596.42
France (franc)	1,083	773.69	870.41
FRG (mark)	354.88	253.49	285.17
Italy (lira)	218,324	155,945	175,439
Japan (yen)	28,499	20,356	22,901
Netherlands (guilder)	401.29	286.64	322.47
South Africa (rand)	220.69	157.64	177.34
Spain (peseta)	19,622	14,015	15,767
Sweden (krona)	1,013	723.33	813.74
Switzerland (franc)	299.47	213.90	240.64
UK (pound)	99.07	70.77	79.61
US (dollar)	112.00	80.00	90.00

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[1] Calculated using currency exchange rates published in the *Wall Street Journal* on January 31, 1985.

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NUEXCO

CURRENT MARKET DATA

RECENT TRANSACTIONS[1]

Uranium Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U_3O_8 equivalent)	Approximate Price as Percent of Current E.V.	Seller	Buyer	Remarks
3291A	1985	301-600	R[2]; see remarks	European Utility	US Fabricator	LEU (assumes 0.3% tails assay). Not an arm's length transaction.
3269	1985	101-300	103	US Producer	US Utility	

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[1] Transactions listed are not limited to those in which Nuexco was involved, but also include others of which Nuexco is aware.
[2] The notation *R* means that Nuexco either does not know, or that Nuexco has restricted that information to protect client confidentiality.

Secondary Market Conversion Services

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U equivalent)	Approximate Price as Percent of Current C.V.	Seller	Buyer	Remarks
3288	1985	300-601	100	US Utility	European Utility	

Enrichment Services
Secondary Market Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity[2] (thousands of SWUs)	Approximate Price[3] as Percent of Current SWU Value[4]	Seller Group	Buyer Group	SWU Origin	Remarks
3291B	1985	50-100	R[5]	European Utility	US Fabricator	R[5]	LEU (assumes 0.3% tails assay). Not an arm's length transaction.
3264	1985	less than 50	91	R[5]	European Utility	DOE	Occurred in late 1984.

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[1] Transactions listed are not limited to those in which Nuexco was involved, but also include others of which Nuexco is aware.
[2] If tails assay is unknown or unspecified, Nuexco's calculation of SWU quantity assumes 0.30 w/o tails assay.
[3] Price is not normalized to 0.30% tails assay.
[4] Refers to SWU Value that corresponds to SWUs included in transaction. When prices and SWU values are expressed as discounts (e.g., X dollars less than DOE's USEC base price at time of delivery), the percentage refers to the ratio of the *discounts,* not the ratio of the prices.
[5] The notation *R* means that Nuexco either does not know, or that Nuexco has restricted that information to protect client confidentiality.

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CURRENT MARKET DATA

URANIUM SUPPLY
(January 31, 1985)

Nuexco Project Number	Spot or Near-term[2]	Intermediate or Long-term	Remarks
	Delivery Period[1] (Thousands of Pounds U$_3$O$_8$)		
Available for Sale:			
ACTIVE			
1575	500	500 per year	
1860	400	1,500 per year	
2038	1,000	1,000 per year	UF$_6$
2134*	220	220 per year	1986-87
2236*	200	200 per year	1986-89
2288A	40	—	
2288B	295	—	UF$_6$
2389*	200	—	
2392	35	—	UF$_6$
2499	15	—	
2516	200	—	
2538*	35	—	
2538A*	130	—	UF$_6$
2565	400	—	
2569	200	—	
2584*	300	—	
2603*	10	—	
2263	—	500 per year	1985-90
2625	—	300 per year	1988-97
2657*	—	980	1986; UF$_6$
TOTAL:	4,180		
INACTIVE			
2191	125	—	UF$_6$
2275	150	—	
2335	275	—	
2336	250	250 per year	1985-94
2495	130	—	UF$_6$
2509	1,200	1,600	UF$_6$
2553	300	—	
2664*	250	250 per year	UF$_6$
0564	—	1,000 per year	1985-90
2271	—	500 per year	1985-88
2297	—	200 per year	1986-89
2326	—	1,000 per year	1989-91
2368	—	250 per year	1987-90
2514	—	1,000 per year	
2574	—	500	UF$_6$
TOTAL:	2,680		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.
Projects removed since last month: 2473.

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URANIUM DEMAND
(January 31, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Spot or Near-term[2]	Intermediate or Long-term	Remarks
Inquiries to Purchase:			
ACTIVE			
2457A*	130	—	
2548	300	—	
2590	475	—	U_3O_8 or UF_6
2636*	200	—	
2690*	160	—	
2217	—	1,000 per year	1989-95
2442	—	4,000	1986-95
2507	—	600	1987-89
2540	—	400 per year	1989-94
TOTAL:	1,265		
INACTIVE			
2329	500	—	1985
2576	20	—	UF_6
2638*	350		UF_6
1999	—	50 per year	1986-90
2244	—	350 per year	1987 on
2414*	—	365	1987-88
2457B*	—	650	1987
2586	—	300	1987
2643	—	150 per year	1987 on
2674*	—	1,000	
TOTAL:	870		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes material deliverable within one year under other than spot of near-term contracts.
Projects removed since last month: 2533, 2419B.

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CURRENT MARKET DATA

CONVERSION SUPPLY AND DEMAND
(January 31, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U as UF_6) Within 3 Years	Beyond 3 Years	Remarks
Available for Sale:			
ACTIVE			
TOTAL:	0		
INACTIVE			
2051	1,000	—	
2438	500	250 per year	1986-87
2511	600	700	1986-90
TOTAL:	2,100		
Inquiries to Purchase:			
ACTIVE			
2602*	460	—	
2638A*	300	—	
TOTAL:	760		
INACTIVE			
2644*	—	475	1987 on
2587*	285	—	
TOTAL:	285		

*New or revised since last month.

[1] Measured from the date of this Report.

Projects removed since last month: 2141.

LOAN SUPPLY AND DEMAND
(January 31, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Within 1 Year	Beyond 1 Year	Remarks
Available for Loan:			
INACTIVE			
1938	2,000	—	UF_6
2128	700	—	
2139	2,000	—	
2469A	800	—	
2483	550	—	
TOTAL:	6,050		

*New or revised since last month.

[1] Measured from the date of this Report.

No inquiries to borrow this month.

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SWU SUPPLY
(January 31, 1985)

	Delivery Period[1] (Thousands of SWUs)		
Nuexco Project Number	Spot or Near-term[2]	Intermediate or Long-term	Remarks
Available for Sale:			
ACTIVE			
2100	150	100 per year	
2359*	—	200	
2583	50	—	
2624	100	—	
2631	150	—	
2632	25	—	
2689*	40	—	
2285	—	300	
2513	—	25	1986
2517	—	150	1986-89
2571*	—	55	1987
2657A*	—	175	1986
TOTAL:	515		
INACTIVE			
2164	25	—	
2589	50	—	
2378*	—	120	1988
2510*	—	50	
2531	—	150	1987
TOTAL:	75		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes SWUs deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: None.

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CURRENT MARKET DATA

SWU DEMAND
(January 31, 1985)

	Delivery Period[1] (Thousands of SWUs)		
Nuexco Project Number	Spot or Near-term[2]	Intermediate or Long-term	Remarks
Inquiries to Purchase:			
ACTIVE			
2459	30	—	
2480	30	—	
2655	10	—	
2665*	50	—	
2519	—	30 per year	1987 on
2578	—	100	1986
2640*	—	40	1987
2653	—	100	1986-90
2658	—	5	1986
2689A*	—	40	1986
TOTAL:	120		
INACTIVE			
2543	25	25	1986
2585*	90	90	1986
2500	—	500	1987-90
2512	—	15 per year	1987 on
2595	—	50	1986
TOTAL:	115		

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*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes SWUs deliverable within one year under other than spot or near-term contracts.
Projects removed since last month: 2443.

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PRIMARY MARKET CONVERTERS IN THE USA

The current uranium enrichment technology requires a gas as feed material, and commercial milling technologies produce natural uranium in solid form. Therefore, the enrichment process requires the conversion of solid uranium concentrates to a gas, uranium hexafluoride (UF_6). The conversion process is performed by five primary converters in the Western world. Because it represents only about three percent of fuel cycle costs (and less than one percent of electricity costs), the conversion process often is overlooked. UF_6 stockpiles at conversion plants and declining sales have caused converters to operate at substantially less than nameplate capacities. In today's buyers' market, the oversupply has not yet been counteracted by strong demand; in fact, the oversupply continues to grow. Although converters' inventories further complicate the true conversion supply situation, it is clear that there is already in place more conversion capacity than necessary for at least fifteen years. Nuexco forecasts indicate worldwide UF_6 consumption will be approximately 30,000 metric tons of uranium (MTU) in UF_6 in 1985, 40,000 MTU in 1990, and 45,000 MTU in 1995 (Table 1). On the other hand, current Western world conversion capacity already exceeds 50,000 MTU per year (Table 2).

Two companies in the USA provide conversion services for the world market. Allied Chemical, a division of Allied Corporation, converts uranium concentrates to UF_6 at its facility in Metropolis, Illinois. Sequoyah Fuels Corporation, a subsidiary of Kerr-McGee Corporation, converts natural uranium at its plant in Gore, Oklahoma.

Table 1

WORLD CONVERSION REQUIREMENTS FORECAST[1]
(Thousands MTU in UF_6)

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
United States	9.9	12.6	11.7	12.4	12.5	12.5	12.9	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6
Europe[2]	13.1	16.6	16.7	17.3	17.6	18.0	18.3	18.4	19.5	20.2	19.4	20.6	20.2	20.9	20.2
Far East[3]	4.3	6.1	6.2	6.4	7.1	7.5	7.3	8.6	8.9	8.6	9.5	9.8	10.3	10.7	10.0
Other Nations[4]	1.7	1.8	2.0	2.1	2.6	2.4	2.5	2.3	3.0	2.6	3.1	2.6	2.8	2.8	2.8
TOTAL[5] [6]	29.0	37.1	36.6	38.2	39.7	40.4	41.1	41.9	43.9	43.9	44.5	45.5	45.8	47.0	45.6

[1] Table ignores lead time for conversion. Consumption is based on computed quantities of U_3O_8 used to fabricate fuel for loading and reloading reactors operating, under construction, on order or forecasted as of November 15, 1984. Compiled and computed on a reactor-by-reactor basis; quantities for each reactor are based on specific core characteristics, 0.25% tails assay, no recycling, 24-month lead time for procuring first cores and 12-month lead time for procuring each reload. The estimates reflect annual consumption and not refueling quantities. First core fuel previously procured is not included.

[2] Austria, Belgium, Finland (two Swedish-supplied plants), France, Germany (FRG), Italy, Netherlands, Portugal, Spain, Sweden, Switzerland, United Kingdom, and Yugoslavia.

[3] China (PRC), Japan, Korea, Philippines, Taiwan.

[4] Argentina, Brazil, Canada, Egypt, India, Mexico, Pakistan, South Africa.

[5] Excludes Bulgaria, Cuba, Czechoslovakia, Germany (GDR), Finland (two USSR-supplied plants), Hungary, Poland, Rumania, and the USSR.

[6] Columns may not add, due to rounding.

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The two companies provide conversion for most of the reactors in the USA, and for about forty percent of the reactors worldwide (Table 2).

Table 2

MARKET SHARES OF PRIMARY CONVERTERS[1]

Converter	Plant Location	Capacity (MTU/year)	Market Share (%)	
			USA	World
Allied Chemical	Metropolis, Illinois	12,700	45	20
Sequoyah Fuels	Gore, Oklahoma	9,000	40	21
Other Converters[2]	—	33,000	8	46
Uncovered or Unknown	—	—	7	13

[1] Based on the number of operational reactors (commercial or not) supplied by each converter.

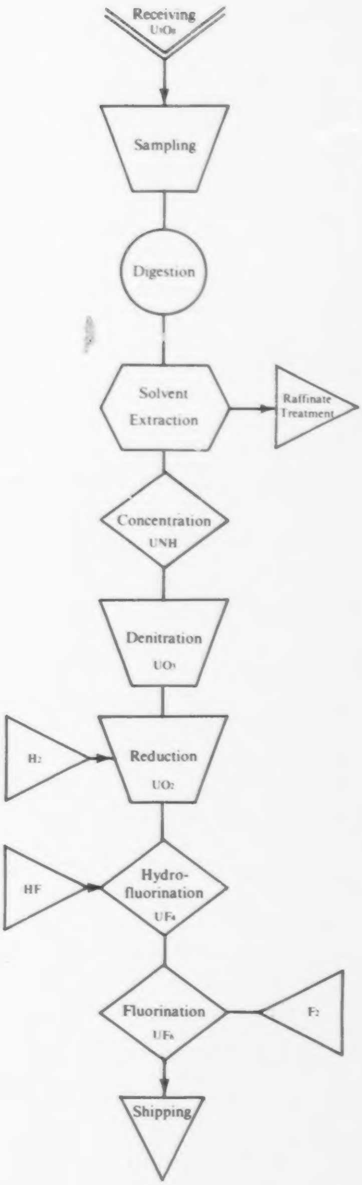
[2] BNFL (British Nuclear Fuels, Ltd.), Comurhex, Eldorado.

Allied began converting uranium concentrates at its plant in Metropolis, Illinois, in 1959. Using the dry fluoride volatility process, Allied currently has an annual capacity of 12,700 MTU, and has shipped over 150 million pounds of UF_6. The dry process is used to convert solid natural uranium concentrates only, the most common form. Sequoyah Fuels began operation in 1970 with an annual conversion capacity of 4,550 MTU. In 1978, Sequoyah expanded the facility, increasing its annual capacity to 9,000 MTU and introduced technology capable of processing slurry forms of uranium concentrates, which are becoming more prevalent due to the increasing use of alternative recovery methods. The conversion of slurry through the wet process eliminates the need for drying and packaging slurry at the milling site.

Sampling

Solid natural uranium concentrates (U_3O_8) are shipped by truck from a mill. Upon receipt, each 55-gallon drum is weighed, and the powder is dumped into an elevated hopper for sampling. Both Allied and Sequoyah Fuels retain an independent weighing and sampling firm, Lucius Pitkin, Inc. The concentrates are sampled for moisture content, uranium content and impurities, as well as overall weight.

Figure 1. Wet Conversion Process



Pitkin utilizes the falling-stream method of sampling, in which several sample cutters remove ten percent of the material dumped in a falling stream from the feed batch. The process is repeated several times to insure a representative sample. Both the shipper and the receiver (converter) accept Pitkin's results on moisture content and weight. To verify uranium content and impurities, samples are sent to both producer and converter. If the parties agree to within 0.20 percent (Allied requires agreement to within 0.21 percent), the results are deemed acceptable. If they do not agree, the sample can be umpired, in which case the losing party pays for the independent umpiring.

At Sequoyah Fuels, uranium concentrates received in slurry form from solution mining usually arrive via tank trailer with approximately 4,000-gallon capacity. Nitric acid is added to the tank to dissolve the slurry, and the solution is pumped to a weigh tank for measurement and sampling.

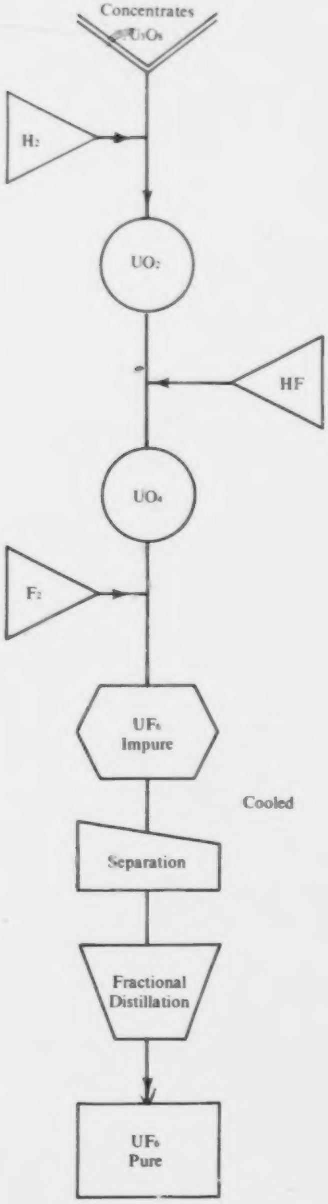
Conversion

In Sequoyah's wet process, conversion begins with the dissolution of uranium concentrates into uranyl nitrate using nitric acid (Figure 1). After the nitric acid digests the concentrates the solution is similar to the slurry-nitric acid mixture found in the tank trailers (to which it often is added). Various solvent extraction methods follow, in which the uranyl nitrate is scrubbed of impurities. The uranium is separated from the acid solution by mixing with organic solvents and settling, leaving the impurities in the acid solution. This barren acid solution, or raffinate, is removed and the purified uranyl nitrate is re-extracted into water. A concentration step follows, in which evaporation concentrates the weak uranyl nitrate solution into molten uranyl nitrate hexahydrate (UNH), an intermediate which subsequently undergoes denitration (the removal of the nitrate through thermal decomposition) to form uranium trioxide (UO_3).

The next steps involve the reduction and fluorination of the UO_3 powder. Hydrogen is introduced, capturing oxygen to form UO_2 and water (H_2O). The UO_2 powder then reacts with hydrofluoric acid (HF) to become UF_4, known as green salt. Finally, the UF_4 reacts with elemental fluorine to form UF_6. Allied and Sequoyah Fuels manufacture their own fluorine; Sequoyah produces fluorine gas by electrolysis at the conversion site, while Allied operates a commercial hydrofluoric acid (HF) plant in Geismar, Louisiana.

Sequoyah Fuels processes slurry by adding nitric acid to the slurry in the tank trailer for digestion, and pumping

Figure 2. Dry Conversion Process



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the solution into weigh tanks for measurement. Liquid samples are taken, and the solution joins the separation system.

Allied's dry process differs from wet processing in several ways. The first step consists of the direct fluorination of the U_3O_8 concentrates (Figure 2). Hydrofluoric acid reacts with the uranium oxides or ammonium diuranate (ADU), and the impure UF_6 undergoes a series of purification steps. Problems in the dry process can arise when magnesium or sodium uranates are used; the HF reaction forms sticky products which can adhere to the reactor walls at the conversion facility. No significant differences in quality of UF_6 have been found between the two conversion processes, although the wet process contains the flexibility to convert slurries and other non-solid forms of feed material.

Following conversion, the UF_6 gas enters cold traps designed to liquify the gas so it can be drained into shipping cylinders. As the cylinders cool to room temperature, the UF_6 solidifies. Because of the tremendous weight of the solid UF_6, a truck can transport only two ten-ton (6,400 Kg) cylinders at a time. Fourteen-ton (8,400 Kg) cylinders often are used when shipping overseas. The cylinders are then ready for shipment to one of DOE's enrichment plants, or, in some cases, to an overseas enrichment plant.

Conversion Supply and Demand

It is difficult to determine true world supply figures for conversion. Most of the facilities in operation today currently operate well below full nameplate capacity because of the industry's oversupply situation. The flow of uranium concentrates into conversion facilities remains greater than the flow of UF_6 to enrichment plants, resulting in the buildup of large stockpiles at the conversion sites. Moreover, the rate at which the converter processes material is subject to a number of variables, including the efficiency of the electrolytic elemental fluorine plant.

Similarly, conversion demand can be influenced by many variables. A higher enrichment tails assay would result in increased uranium demand, proportionately increasing the need for UF_6. Reprocessing, with respect to both uranium recycling and plutonium, would reduce significantly the demand for natural uranium, but commercial applications are a long-term consideration and should not affect conversion demand in this century. These uncertainties pose only minor problems for converters when planning for expansion or a new facility, the construction of which requires a lead time of approximately five years.

In March 1985, DOE will announce its intentions for the future of uranium enrichment in the USA. One of the new technologies under consideration, Atomic Vapor Laser Isotope Separation (AVLIS), is a method of drawing off the U_{235} isotope by laser excitement. This process uses uranium metal as feed material for enrichment, instead of UF_6. Should DOE decide to proceed with AVLIS as its enrichment technology of the future, the conversion industry in the USA would be forced to adapt accordingly.

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AUSTRALIA

In view of the current state of the uranium market, the announcement by Energy Resources of Australia, Ltd. (ERA) of two long-term supply contracts with US utilities was both surprising and revealing. The agreement with American Electric Power (AEP) is actually a renegotiation of the original AEP-Ranger agreement under which deliveries had been suspended because market prices had fallen well below the Australian floor price. The second agreement is with Pennsylvania Power & Light.

Notwithstanding the press response to the ERA announcement, it is most unlikely that US utilities would agree to terms that could require them to buy large amounts of uranium at prices substantially higher than spot market prices. Accordingly, it is probable that these agreements are, in effect, *call* options that allow considerable delivery flexibility and provide that if, as, and when market prices exceed the Australian floor price, the utilities may call on ERA for delivery at discounts from market price. Alternately, the contracts could be structured as *put* options, giving ERA the right to deliver to the utilities at prices below market whenever certain contract terms are met, such as market price exceeding the Australian floor price for a specified period. In either case, the contracts probably do not require the utilities to take and pay for any meaningful quantities while market price is below the Australian floor.

Perhaps the greatest significance of these contracts is the continuing, subtle maneuvering for position between ERA and the Olympic Dam project (Roxby Downs). As ERA adds customers, Olympic Dam's roster of potential customers is reduced accordingly. If the present floor price is maintained (or raised), neither ERA nor Olympic Dam would be able to export under market price contracts until market prices rise sharply or the floor price is reduced. In either case, ERA's ability to increase capacity rapidly and at lower cost per unit seems to give it a considerable advantage over Olympic Dam, which has to base load, finance, and construct an entirely new facility.

However, the Olympic Dam partners, Western Mining and British Petroleum, have their own unique situation. Preliminary marketing is under way, and with copper and gold as co-products, usual financing requirements may be alleviated. This would allow uranium production to begin at levels that might be sub-economic in a stand-alone uranium operation. Finally, the Olympic Dam project presents the prospect of supply diversity within Australia combined with very large, long-term reserves backed by financially responsible ownership.

* * *

Western Mining Corporation (WMC) and BP Australia, the joint venture partners in the Olympic Dam project (Roxby Downs), have commissioned Fluor Corporation to carry out a technical study. The study will be completed in March 1985 and is part of the A$150 million feasibility study now in progress. Because market demands for the planned copper and uranium production are limited, the project will be designed to reach full production in stages. The first stage will be designed to treat high-grade ore averaging three percent copper, 3.3 pounds U_3O_8 and 0.4 grams of gold per ton of ore. Annual yield would be 2,000 metric tons of U_3O_8 and 55,000 metric tons of copper starting in 1988. Gold production could begin earlier at a rate of 100,000 ounces per year. Part of the study will review the work done to date, but it also signals the further acceleration of the project by WMC and BP toward their goal of beginning production in the late 1980s.

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RECENT DEVELOPMENTS

SOUTH AFRICA

Fourth quarter production from Chamber of Mines producers amounted to approximately 3.4 million pounds U_3O_8, down slightly (4 percent) from the 3.5 million pounds produced in the third quarter, and the average of 3.7 million pounds produced in the first three quarters of 1984. Most of this decline can be attributed to the following factors:

1. An 85-percent drop in production at Beisa (St. Helena) following the cessation of mining operations and the completion of underground reclamation;
2. A 40-percent decline in production at Blyvooruitzicht due to the slowing of operations following a decision to cease production by 1985;
3. A 31-percent decline at Driefontein Consolidated because of lower grades and a reduction of throughput in the closing months of 1984.

These losses were partially offset by a 37-percent production increase at JMS (Free State Joint Metallurgical Scheme), and a 10-percent increase at Buffelsfontein.

* * *

Total production in 1984 of 14,531,000 pounds U_3O_8 was five percent less than 1983 (Table 3). Eight producers experienced declines in production totalling approximately 1.2 million pounds, over 60 percent of which was attributed to Harmony, Beisa, and JMS (notwithstanding its fourth-quarter production increase). This decline was partially offset by increases in production by three producers amounting to approximately 450 thousand pounds. Randfontein and Vaal Reefs contributed 90 percent of the increase.

South Africa's gold and uranium industries experienced a relatively prosperous year despite lower US dollar prices for gold (Table 4). South Africa's contracts customarily are denominated in US dollars. Although most South African uranium sales involve long-term contracts in which spot prices do not play a crucial role, examining the relationship between the Exchange Value expressed in dollars and that expressed in rands can give an indication of the currency exchange rate's effect on long-term uranium prices. The Exchange Value declined 31 percent in dollar terms during 1984, but the 61-percent increase in the currency exchange rate caused the Exchange Value to rise 12 percent in rand terms. Moreover, because the prices South African producers received under long-term contracts did not decline in dollar terms nearly as much as did the Exchange Value, South Africa's long-term prices increased in rand terms even more than the 12 percent by which the Exchange Value increased. The severe depreciation of the rand in relation to the dollar also resulted in record rand gold prices. Since by-product and co-product uranium production from gold mining in general costs less than primary uranium production, the gold/uranium operations strongly contributed to the viability of the uranium industry in South Africa.

Palabora Mining Company (PMC) announced in its annual report to shareholders that it sold 502 thousand pounds of uranium concentrates in 1984. This represents a 29-percent increase from the 356 thousand pounds sold in 1983. PMC, which is not a member of the Chamber of Mines, produces uranium as a by-product of its copper-mining operations.

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Table 3

REPUBLIC OF SOUTH AFRICA: 1984 URANIUM PRODUCTION[1]

(Thousands of pounds U_3O_8)

Operation	First Quarter 1984	Second Quarter 1984	Third Quarter 1984	Fourth Quarter 1984	Total 1984 Production
Beisa (St. Helena)[2]	338	333	107	16	794
Blyvooruitzicht	155	132	142	85	514
Buffelsfontein	313	331	337	371	1,352
Chemwes (Stilfontein)	310	279	290	276	1,155
Driefontein Consolidated	98	104	88	61	351
ERGO[3]	113	94	71	84	362
Harmony	307	259	274	255	1,095
Hartebeestfontein	248	253	225	237	963
JMS[4]	356	265	293	402	1,316
Randfontein	287	361	361	297	1,306
Vaal Reefs	1,069	1,129	1,078	1,052	4,328
Western Areas	175	171	164	163	673
Western Deep Levels	79	82	83	78	322
TOTAL	3,848	3,793	3,513	3,377	14,531

[1] Excludes Palabora Mining Company, which is not a member of the Chamber of Mines.

[2] Mining operations ceased and underground reclamation completed.

[3] ERGO = East Rand Gold and Uranium Co. Ltd.

[4] JMS = Free State Joint Metallurgical Scheme.

Table 4

URANIUM AND GOLD PRICES

Date	Nuexco Exchange Value (per lb. U_3O_8)	Percent Change	Gold Price (per ounce)	Percent Change	Exchange Rate (rand/dollar)	Percent Change
December 30, 1983					1.2182	
US Dollars	22.00		381.50			
SA Rand	26.80		464.74			
December 31, 1984					1.9666	+61
US Dollars	15.25	−31	309.00	−19		
SA Rand	29.99	+12	607.68	+31		

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RECENT DEVELOPMENTS

UNITED STATES

DOE announced that it has negotiated a concession from Tennessee Valley Authority (TVA) over the price of electricity purchased for use at two of DOE's uranium enrichment plants, in Paducah, Kentucky and Oak Ridge, Tennessee. Under the agreement, TVA would offer to supply low-cost electricity, called Experimental Test Energy (ETE), during TVA's non-peak hours, and would determine in advance the amount of ETE to be available. This follows Duke Power Company's 1984 offer to sell electricity to DOE at 18 mills/megawatt-hour (MWh), which failed when TVA refused to wheel the power to the enrichment plants.

DOE, in presentations to news media, publicized a 20-percent discount. However, it is clear that the actual savings will finally amount to less than one dollar per SWU. Various reports estimate the discount to be from 37 cents off the base cost per SWU to a 68-cent-per-SWU discount. The following pro forma analysis demonstrates the reasoning by which the estimated savings may be calculated.

Table 5 indicates DOE's approximate power costs before the announcement of the potential TVA agreement.

Given that DOE pays 25 mills per kilowatt-hour for firm energy (without the new discount), Table 5 can be used to estimate that DOE could buy a maximum of about 4,500 megawatts of electricity (MWe) from TVA in a given year. If DOE took less, it still would pay about 11 mills per MWe not taken.

The TVA discount for ETE could apply on weekends, holidays, and from 10 p.m. to 6 a.m. on weekdays. In the following calculations, it is assumed that the discount would be applied 40 percent of the time. The average TVA price for firm energy then becomes 23 mills per kilowatt-hour. If DOE continues to take 500 MWe per year from TVA, the average TVA price with the new discount will be:

$$\frac{11\,(4{,}500 - 500) + 23\,(500)}{500}$$

$$= 111 \text{ mills per KWh}$$

The overall price averaged over all suppliers will be:

$$\frac{(500 \times 111) + (1{,}380 \times 18.5) + (735 \times 23.6)}{2{,}615}$$

$$= 37.6 \text{ mills per KWh}$$

This represents an actual power cost reduction of one percent over the current cost of 38.0 mills per KWh, provided DOE does not redistribute their energy demand.

Assuming that 50 percent of the DOE SWU price to utilities is ascribed to energy costs, the TVA discount could yield a SWU price reduction of 0.5 percent, or 68 cents, if such a discount were fully passed on to the customers. Other assumptions would yield different numbers, but the reasoning would remain the same.

Table 5

DOE POWER COSTS

	Before July 1984		July 1984 to Oct. 1984		After Oct. 1984	
Source	Amount Purchased (MW/yr)	Unit Cost (mil/KWh)	Amount Purchased (MW/yr)	Unit Cost (mil/KWh)	Amount Purchased (MW/yr)	Unit Cost (mil/KWh)
TVA	1,140	57.3[1]	650	91.1[1]	500	113.2[1]
OVEC[2]	1,260	17.9	1,260	17.9	1,380	18.5
EEI[3]	735	22.1	735	22.1	735	23.6
Total (Average)	3,135	(33.2)	2,645	(37.1)	2,615	(38.0)[4]

[1] Includes charge for power not taken.
[2] OVEC = Ohio Valley Electric Corp.
[3] EEI = Electric Energy Inc.
[4] Represents a 14.5-percent increase over the pre-July price.

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1984 US URANIUM ACTIVITIES

Introduction

Uranium exploration and mining activities decreased steadily throughout 1984 as the market for uranium concentrates continued the downward trend that began during the last quarter of 1983. Reduced competition for limited sales opportunities created a brief respite in the price decline, holding the Nuexco Exchange Value at $17.50 per pound U_3O_8 during the period June through September. However, as sellers adjusted to renewed market pressure, even lower prices prevailed. By year end, the Nuexco Exchange Value had reached $15.25, its lowest level since January 1975.

US uranium production for 1984 is estimated by Nuexco at about 15.4 million pounds, down from 21.2 million pounds in 1983. Solution mining in the South Texas district and phosphoric acid production in Florida and Louisiana accounted for almost 35 percent of the 1984 output. Conventional production centers continued to curtail activities during the year. Three milling operations closed down for six or more months, and several other projects were put on temporary stand-by, announcing intent to resume operations as the market recovers.

Exploration and development drilling activity declined as expected based on an active rig count. Nuexco estimates total drilling at 2.0 to 2.5 million feet as compared to DOE's estimate of 3.5 million feet for 1983. (*Note:* DOE no longer collects drilling and ore reserve information related to the uranium resource industry.) Nuexco's estimate is based on information supplied by a survey of selected companies.

Exploration drilling by at least six companies in the South Texas district averaged seven working rigs per month throughout the year; development drilling averaged six rigs per month.[1] Throughout Arizona, Colorado, Nebraska, New Mexico, Utah and Wyoming, at least 13 companies participated in drilling, with an average monthly rig count of 14 for exploration drilling and seven for development drilling. In the Grants, New Mexico district, for many years the most active district in the USA, there was no exploration drilling for eight months of the year, but one to four companies drilled during August to fulfill annual property requirements; development drilling was limited to nine months with one to three rigs.

Active Projects

Exploration activity in the South Texas district continued along known geologically favorable trends located primarily in Duval, Brooks and Kleberg counties. The favored targets were fine to coarse sand and conglomerate units of the Goliad Formation. Further north in Live Oak and Bee counties, the main target remains the Oakville Sandstone. There were no significant discoveries announced in 1984; however, development drilling in certain areas proved successful in delineating additional reserves and enhancing certain active solution-mining operations.

The area north and south of Grand Canyon National Park experienced a slight surge in activity. Five or six major uranium companies continued to acquire new ground for exploration, including geophysical and drilling programs. The exploration target is potentially high-grade deposits in breccia pipe structures common to the district. In addition, another eight to ten small exploration companies and independent operators competed for the more favorable exploration targets. Constructive exploration was limited primarily to annual work requirements related to conditions of property acquisition.

Energy Fuels Ltd. (EFL) remains the most aggressive and successful operator in the district. EFL presently is mining three highly mineralized breccia pipe deposits and is developing a fourth scheduled for production sometime in late 1987 or early 1988. In addition, EFL has applied to federal and state agencies with the intent of developing yet another deposit. The proposed project site is the Canyon pipe located on the south side of the Grand Canyon. If the project proceeds, it will be the first uranium mining in the southern rim district since the Orphan pipe was last mined in 1969.

Ferret Exploration Company continued to explore its Big Red property in Dawes and Box Butte counties of Nebraska. The mineral trend at the large Crow Butte deposit has been traced for several miles south onto the Big Red property. Ferret remains optimistic about property potential as a result of the important uranium resources identified to date.

Development of the Crow Butte project (owned 50 percent by Wyoming Fuel Company and 50 percent by Ferret) has been delayed by the permitting process. The joint venture anticipates licensing and permitting requirements will be in place in early 1985 and construction of a solution-mine pilot plant should begin by mid-to-late 1985.

Everest Minerals Corp. is continuing project feasibility studies on its Highland property located in South Powder River Basin, Wyoming. Everest has announced its intent to develop a solution mine on the property, probably during the second half of 1986. The ore deposit is a down-dip westward extension of Exxon's open pit, which closed in March 1984.

Events that further affected the US uranium industry in 1984 are listed chronologically in Table 6.

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[1] It should be noted that by Nuexco estimate, drilling time per rig varies from 1 to 23 days per month and may average less than 10 working days per rig; thus, footage drilled was held below normal capabilities.

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RAW MATERIALS

Table 6

1984 URANIUM-RELATED ACTIVITIES IN THE USA

Month	Organization	Event or Announcement
Jan	Union Carbide Corp.	Reached agreement with Energy Fuels for operatorship and 70% of production capacity at the Energy Fuels Mill at White Mesa, Utah.
Jan	Western Nuclear, Inc.	Announced plan to reopen the mine at Ruby Wells, New Mexico.
Feb	Atlas Corp.	Closed the Velvet, Pandora and Rim mines. Announced plans to close the Moab mill; 200 employees affected.
Feb	US DOE	Estimated 1983 production at 21.2 million pounds compared to 26.9 million in 1982.
Feb	United Nuclear Co.	Ended negotiations to purchase Ogle uranium properties in Wyoming.
Mar	Reserve Oil & Minerals Corp.	Agreed to sell its Canadian uranium interests.
Mar	Pathfinder Mines Corp.	Closed its underground mining operations off the pit walls of the Lucky Mc mine, Gas Hills, Wyoming.
Mar	American Nuclear Corp.	Agreed in principle with TVA to end joint venture on properties in Wyoming.
Mar	Exxon Nuclear Co.	Closed its Highland open-pit mine, Powder River Basin, Wyoming.
Mar	Ranchers Corp.	Announced plans to merge with Hecla Mining Co.
April	Caithness Corp.	Began restoration at the McBryde solution mine, Hebbronville, Texas.
April	Tenneco Minerals Co.	Suspended production at West Cole solution mine, Hebbronville, Texas.
April	Union Carbide Corp.	All mineral resources to operate under new subsidiary—UMETCO Minerals Corp.
April	Plateau Resources Ltd.	Closed its mine at Shootaring Canyon, Utah.
June	Quivira Mining Co.	Laid off 276 employees in 40% cutback of mine and mill operations.
June	Exxon Nuclear Co.	Closed its Highland mill, Powder River Basin, Wyoming.
July	Western Nuclear, Inc.	Will reopen the Ruby Wells mine, recalling 70 employees.
July	Union Carbide Corp.	Announced intent to put all mining projects on standby during fourth quarter.
Aug	Western Nuclear, Inc.	Closed its Sherwood, Washington mine and mill.
Aug	Tennessee Valley Authority	Announced offer to sell open pit properties, Gas Hills, Wyoming.
Sept	Homestake Mining Co.	Placed its Grants, New Mexico mill on standby; 60 employees affected.
Oct	Union Carbide Corp.	Closed mills at Uravan, Colorado and Gas Hills, Wyoming. 30 employees laid off.
Nov	Federal Trade Commission	FTC approved merger plan for Chevron Corp. and Gulf Corp. Chevron will control the Mt. Taylor deposit, Grants, New Mexico.

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Table 6
1984 URANIUM-RELATED ACTIVITIES IN THE USA *(continued)*

Month	Organization	Event or Announcement
Nov	Homestake Mining Co.	Broke off negotiations with Midas, Inc., for participation in mine development at Grants, New Mexico.
Dec	American Nuclear Corp.	Reached final agreement with TVA to settle joint venture relationship in relation to properties in the Gas Hills and Powder River Basin, Wyoming.
Dec	Energy Fuels Nuclear, Inc.	Applied for permits to develop breccia pipe deposit on south side of the Grand Canyon, Arizona.
Dec	Union Carbide Corp.	Suspended uranium exploration affecting 50 employees; announced intent to stop all mining projects by March, 1985.
Dec	Pathfinder Mines Corp.	Will spend $4 million to modernize the Lucky Mc mill, Gas Hills, Wyoming.
Dec	Homestake Mining Co.	Recalled 20 employees in preparation of mill startup in early January.

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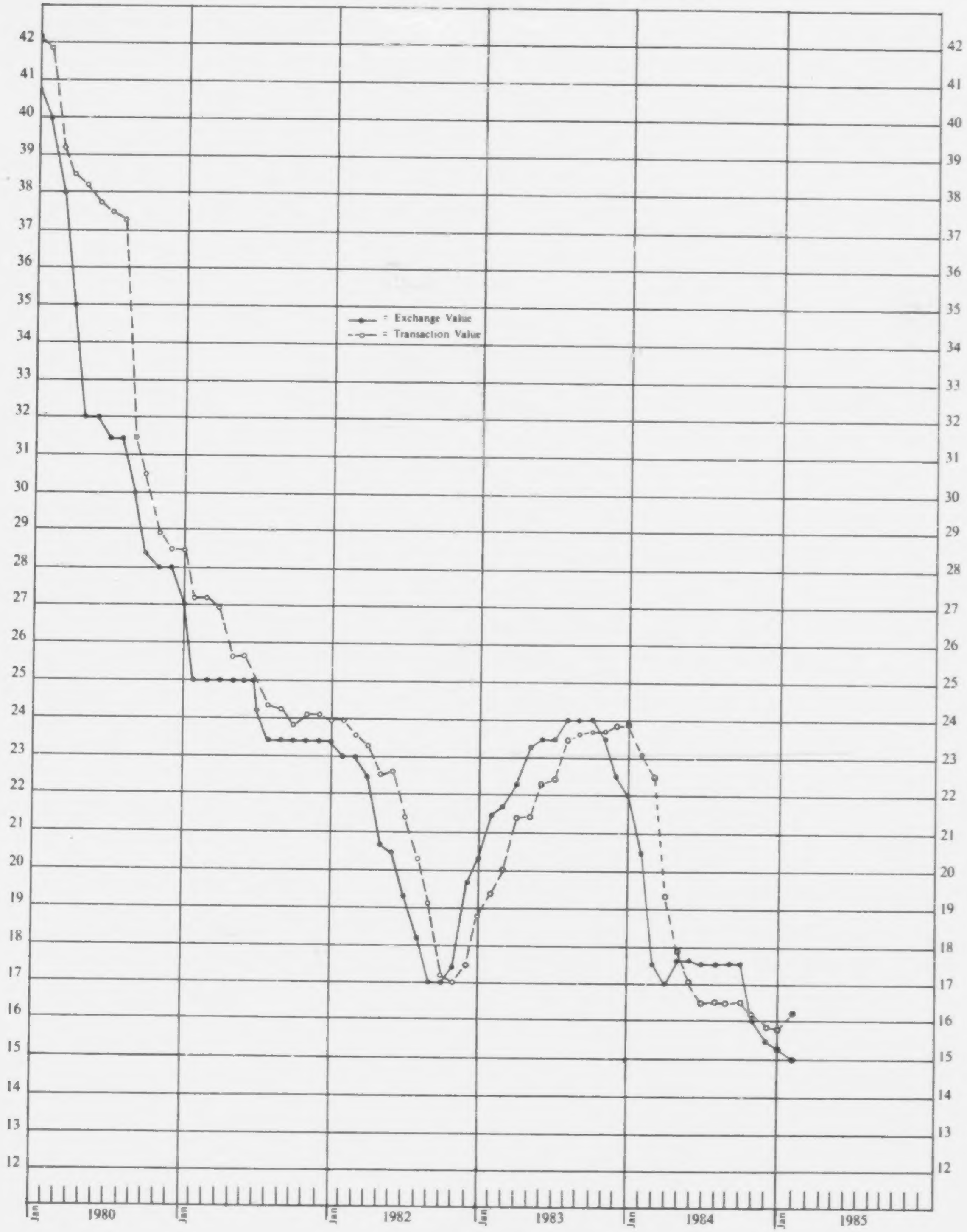
HISTORICAL MARKET DATA

EXCHANGE AND TRANSACTION VALUES SINCE JANUARY 1980

Determined as of the last day of the month indicated



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HISTORICAL MARKET DATA

HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	—	—	—	—	—	—	—	6.35	6.35	6.40	6.45	6.50
1969	—	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	32.50	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00
1981	25.00	25.00	25.00	25.00	25.00	24.25	23.50	23.50	23.50	23.50	23.50	23.50
1982	23.00	23.00	22.50	20.75	20.50	19.25	18.25	17.00	17.00	17.50	19.75	20.25
1983	21.50	21.75	22.25	23.25	23.50	23.50	24.00	24.00	24.00	23.50	22.50	22.00
1984	20.50	17.50	17.00	17.75	17.75	17.50	17.50	17.50	17.50	16.00	15.50	15.25
1985	**15.00**											

HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	—	—	—	—	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38.40	37.90	37.60	37.30	31.60	30.60	29.00	28.70	27.70
1981	27.20	27.20	27.00	25.70	25.70	24.50	24.40	24.30	23.90	24.10	24.10	24.00
1982	24.00	23.70	23.40	22.60	22.70	21.50	20.30	19.10	17.30	17.00	17.55	18.80
1983	19.35	20.00	21.35	21.40	22.35	22.45	23.50	23.60	23.65	23.65	23.85	23.85
1984	23.05	22.50	19.25	17.90	17.00	16.50	16.60	16.40	16.55	16.05	15.90	15.90
1985	**16.20**											

HISTORICAL CONVERSION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U as UF_6)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	1.20	1.20	1.20	1.40	1.15	1.15	1.15	1.10	1.10	1.10	1.20	1.20
1982	1.20	1.20	1.20	1.20	1.00	1.00	1.00	0.90	1.10	1.60	1.45	1.45
1983	1.20	1.40	1.40	1.20	1.20	1.20	1.10	1.10	1.00	0.60	0.60	0.60
1984	0.60	0.30	0.80	0.80	0.80	0.00	0.00	0.80	1.00	1.00	0.80	0.80
1985	**1.00**											

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GOVERNMENT STATISTICS

AUSTRALIA

	Price Index of Materials Used in Manufacturing Industry—All Groups[1] (1969=100)	Award Rates of Pay Indexes Australia—Adult Males In Mining Wage and Salary Earners, Weekly Rates[2] (1976=100)
1983 Avg.	401.2	181.8
Oct 1983	397.5	188.3
Nov 1983	395.5	188.3
Dec 1983	399.2	188.1
Jan 1984	399.2	188.6
Feb 1984	402.5	188.5
Mar 1984	403.9	188.3
Apr 1984	404.2	196.2
May 1984	403.8	197.0R
Jun 1984	404.9	197.0R
Jul 1984	408.5	197.0R
Aug 1984	413.3	197.0R
Sep 1984	412.1	197.0R
Oct 1984	408.6R	197.0
Nov 1984	407.2	197.0

P = Preliminary R = Revised since last month

CANADA

		Wage-earner Data: Average Hourly Earnings (C$)[2]					
	Industry Selling Price Index: Manufacturing[1] (1971=100)	Uranium Mines (SIC 057)	Metal Mines* (SIC 051-059)	Mines, Quarries and Oil Wells[3] (SIC 051-099)	Primary Metal Industries Non-ferrous[4] (SIC 296)	Primary Metal Industries Non-ferrous[4] (SIC 298)	Chemicals and Chemical Products[5] (SIC 372-379)
1983 Avg.	298.8	—	—**	14.30	—	—	11.17
Dec 1983	302.9	17.84	15.11	14.66	11.86	10.60	11.51
Jan 1984	305.4	17.74	15.27	14.74	11.91	10.84	11.69
Feb 1984	306.6	17.78	15.59	14.90	12.04	10.82	11.51
Mar 1984	308.7	18.05	15.52	14.82	12.14	10.84	11.58
Apr 1984	310.5	18.06	15.83	15.10	11.96	10.34	11.63
May 1984	310.6	18.48	15.64	15.06	12.11	10.16	11.65
Jun 1984	311.0	18.08	15.48	14.80	12.38	10.40	11.66
Jul 1984	312.7R	17.81	15.72	14.92	12.53	10.18	11.82
Aug 1984	312.4R	17.24	15.36	14.92	12.44	10.34	11.78
Sep 1984	312.0	17.68	15.96	15.34	12.51	10.52	11.90
Oct 1984	312.3	17.64	16.15R	15.26R	12.69R	10.56R	11.96R
Nov 1984	313.5	18.08P	16.10P	15.35P	12.47P	10.53P	11.99P
Dec 1984	313.9	—	—	—	—	—	—

P = Preliminary R = Revised since last month

For annual averages prior to 1983, and for notes pertaining to these statistics, see pages 23-26 of Report 190 of June 1984.

*The 1980 average for Metal Mines was incorrectly reported as 10.59. The correct average is 10.58 (see Report 190).

**Two different methods were used in the 1983 "Metal Mines" category in reporting survey data, and Statistics Canada did not publish a 1983 average. The March 1983 figure for the old method was 14.73 and for the new method was 14.84. The published average for 1983 in Report 190 was a Nuexco calculation based on the available monthly statistics for 1983 with the exception of the March figure, where only the 14.84 value was taken into account.

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REPUBLIC OF SOUTH AFRICA

	Average Declared Working Costs per per Metric Ton of Gold Ore Milled (Rand)[1]	Tonnage-Weighted Index of Average Working Costs per Metric Ton of Gold Ore Milled (March 1982=100)[2]	Consumer Price Index[3] (1975=100)[4]	Producer Price Index All Groups[5] (1975=100)	Total Employment in Mining and Quarrying (Code 35)[6]	Total Salaries and Wages in Mining and Quarrying (1,000 Rand) (Code 40)[6]
1983 Avg.	51.87	115.0	262.2	274.8	696,579	3,644,772
Nov 1983	—	—	271.4	281.6	688,459	317,485
Dec 1983	53.70	119.6	273.2	283.7	690,750	333,595
Jan 1984	—	—	274.7	283.3	689,807	326,619
Feb 1984	—	—	278.4	286.5	702,553	335,906
Mar 1984	55.30	123.1	281.9	288.0	715,628	342,332
Apr 1984	—	—	286.1	290.2	712,963	327,550
May 1984	—	—	288.3	292.6	710,040	327,937
Jun 1984	56.95	126.2	291.2	295.3	717,009	347,121
Jul 1984	—	—	295.1	296.0	717,121	369,964
Aug 1984	—	—	297.0	300.8	721,905	361,357
Sep 1984	60.64	133.2	299.9	304.1	721,470R	359,218
Oct 1984	—	—	303.7	308.7	717,865	363,755
Nov 1984	—	—	307.4	312.8	—	—
Dec 1984	—	—	309.4	—	—	—

UNITED STATES

	Producer Price Index[1]		Consumer Price Index[2]	GNP Implicit Price Deflator[3]	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[4]			
	Industrial Commodities (1967=100)	All Commodities (1967=100)	(1967=100)	(1972=100)	Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)	Electric and Electronic Equipment (SIC 36)
1983 Avg.	315.8	303.1	298.4	215.63	12.57	13.43	10.59	8.65
Nov 1983	318.3	305.5	303.1	—	12.64	13.56	10.86	8.77
Dec 1983	318.4	306.1	303.5	218.53	12.75	13.33	10.90	8.84
Jan 1984	319.1	308.0	305.2	—	12.67	13.38	10.91	8.88
Feb 1984	320.6	308.9	306.6	—	12.81	13.34	10.90	8.86
Mar 1984	321.9	311.0	307.3	220.58	12.85	13.33	10.95	8.88
Apr 1984	322.5	311.4	308.8	—	12.91	13.30	10.97	8.89
May 1984	323.3	311.7	309.7	—	12.99	13.37	11.02	8.89
Jun 1984	323.9	311.4	310.7	222.40	12.96	13.40	11.03	8.91
Jul 1984	324.0	312.0	311.7	—	13.02	13.36	11.12	8.95
Aug 1984	323.5	310.9	313.0	—	13.10	13.51	11.13	9.00
Sep 1984	322.3	309.5	314.5	224.36	13.20	13.39	11.23	9.08
Oct 1984	323.2	309.4	315.3	—	13.23R	13.53	11.32R	9.09R
Nov 1984	323.8	310.4	315.3	—	13.23	13.76	11.35R	9.15R
Dec 1984	323.0	309.9	315.5	225.90	13.21P	13.65P	11.35	9.26
Jan 1985	—	—	—	—	—	—	11.37P	9.33P

P = Preliminary R = Revised since last month

For annual averages prior to 1983, and for notes pertaining to these statistics, see pages 23-26 of Report 190 of June 1984.

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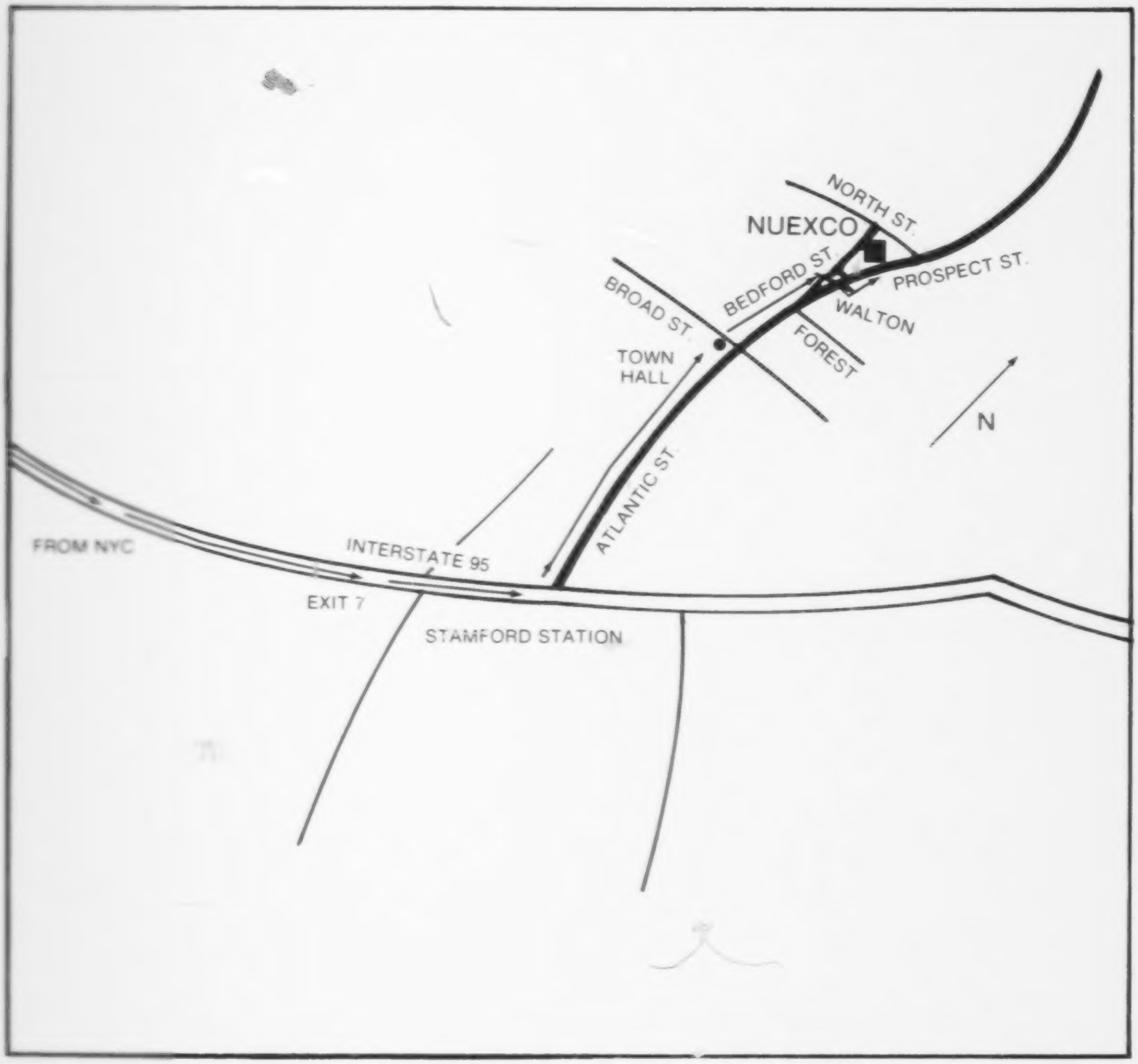
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EXECUTIVE SUMMARY
REPORT 198
(All data as of January 31, 1985)

Exchange Value **$15.00, down $0.25**	The **Exchange Value** is **$15.00** per pound U_3O_8, down $0.25 since last month. One recent natural uranium sale is reported, involving approximately 100 to 300 thousand pounds U_3O_8 equivalent. It involved delivery prior to 1986, and also met the conditions for inclusion in the Transaction Value.
Supply-Demand Ratio **rose to 3.3:1**	Active spot and near-term **uranium supply** amounts to **4.2 million** pounds U_3O_8 equivalent, up 540 thousand pounds since last month. Active spot and near-term **uranium demand** totals **1.3 million** pounds, up 15 thousand pounds. The spot and near-term **supply-demand ratio** increased to **3.3:1.**
Transaction Value **rose to $16.20**	The **Transaction Value** is **$16.20** per pound U_3O_8, up $0.30 since last month. The calculation includes 14 transactions involving a total of 2.1 million pounds U_3O_8 and equivalent UF_6, and covers a period of 7 months.
Loan Use Charge Rate **unchanged at 6%**	The **Loan Use Charge Rate** remains **6 percent** per annum in a dormant market.
Conversion Value **rose to $1.00**	The **Conversion Value** is **$1.00** per pound U as UF_6, up $0.20 since last month. One secondary market conversion transaction is reported, involving approximately 500,000 pounds U as UF_6. Active secondary market demand for conversion services for delivery within three years totals 760 thousand pounds U as UF_6. No active supply is reported.
SWU Values: **$112 for DOE-origin (FY85)** **$15 discount for FY86** **$80 for non-DOE origin (calendar year 1985)** **$90 for calendar year 1986**	The **SWU Values** for DOE origin at .3 tails and certifiable as excess, are **$112** per SWU for FY85 delivery, and **$15** per SWU discount from DOE base price for FY86 delivery, both unchanged from last month. SWU Values for other SWUs (non-DOE or non-certifiable) are **$80** per SWU for calendar year 1985 delivery, and **$90** per SWU for calendar year 1986 delivery. One secondary market SWU transaction is reported, involving less than 50 thousand SWUs. In addition, one low-enriched uranium sale is reported.
Basic Considerations	Allied Corporation and Sequoyah Fuels provide primary UF_6 conversion services in the USA and supply about forty percent of UF_6 conversion for reactors worldwide.
Australia	ERA's two recently announced long-term supply contracts with US utilities probably are structured as call options, the primary effect of which will be to diminish the market available to promoters of the Olympic Dam project.
South Africa	Fourth quarter Chamber of Mines uranium production was the lowest in 1984; total production in 1984 declined, but the depreciation of the rand contributed to another prosperous year for gold/uranium producers.
United States	DOE announced an offer from TVA for low-cost electricity for its enrichment plants, but the actual savings will amount to less than one dollar per SWU.
Raw Materials	Uranium exploration and mining activities in the USA declined steadily in 1984. Many operations shut down as production dropped more than 25 percent.

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NUEXCO REPORT 198 FIGURES OF THE MONTH (January 31, 1985)	This Month (Report 198)	Last Month (Report 197)	12 Months Ago (Report 186)
Exchange Value[1]	15.00	15.25	20.50
Transaction Value[1]	16.20	15.90	23.05
Loan Use Charge Rate[2]	6%	6%	6%
Conversion Value[3]	1.00	0.80	0.60
Near-Term Uranium Supply[4]	4.2	3.6	4.2
Near-Term Uranium Demand[5]	1.3	1.3	0.5
Near-Term Supply-Demand Ratio	3.3	2.9	8.3
Recent Uranium Sales:			
Number of Transactions[6]	1	7	5
Quantity of Material[7]	0.1-0.3	2.6	5.1-10.0
Nuexco SWU Values:[8]			
DOE origin, certifiable as excess, 0.3 tails assay			
FY85 delivery	112	112	—
FY86 delivery	15[9]	15[9]	—
Other SWUs (non-DOE or non-certifiable)			
1985 delivery	80	80	—
1986 delivery	90	90	—
USDOE SWU Prices:			
USEC	135.00	135.00	135.00
AFC	153.00[10]	153.00[10]	138.65
Requirements	157.00[10]	157.00[10]	149.85
Market Value of Enriched UF_6[11] [12]:			
2.5 w/o U_{235}	506	507	586
3.0 w/o U_{235}	656	657	753
3.5 w/o U_{235}	808	810	923
4.0 w/o U_{235}	964	965	1,095

---

[1] US $ per pound U_3O_8 equivalent.

[2] Per annum.

[3] US $ per pound U as UF_6.

[4] Active inquiries to sell, for delivery within 12 months after contract signing (millions of pounds U_3O_8).

[5] Active inquiries to purchase, for delivery within 12 months after contract signing (millions of pounds U_3O_8).

[6] Uranium sales only; does not include loans, conversion, or SWU transactions.

[7] Millions of pounds U_3O_8, equivalent.

[8] US $ per SWU.

[9] Discount from USEC base price on delivery.

[10] Effective 10/1/84.

[11] Calculated using the Nuexco Exchange Value, Conversion Value, and 0.30 percent tails assay. From 10/31/83 through 2/29/84, calculations used the Nuexco SWU Value for DOE origin and FY84 delivery. As of 3/31/84, calculations use the Nuexco SWU Value for DOE origin and FY85 delivery.

[12] US $ per KgU as UF_6, rounded to the nearest $.

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MARCH 1985 NUMBER 199

MONTHLY REPORT

ON THE NUCLEAR FUEL MARKET

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MONTHLY REPORT ON THE NUCLEAR FUEL MARKET

March 1985 No. 199

R. WESLEY MILLER, *EDITOR* CLARK M. BEYER, *ASSOCIATE EDITOR*

PRICING

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Enriched Uranium and SWUs 1

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To Our Readers

We are pleased to announce the election of **James E. Vaughan** as President of Nuexco and **M. J. Reaves** as Senior Vice President.

* * *

T. A. (Tom) Boyden retired from Nuexco on February 28, 1985. Tom spent eleven years with Nuexco evaluating the feasibility and marketing strategies of uranium mining projects worldwide. During this period, Tom visited most of the world's important uranium districts, and shared his insight with Nuexco subscribers in the Raw Materials articles published in the Monthly Report.

Tom plans to continue his participation in the uranium industry as an independent consultant. He has formed TABCO, a company which will specialize in project identification and evaluation, ore reserve assessment, recovery technique, and marketing strategies. We wish him the best of luck.

Tom's new business address:

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Saratoga, CA 95070-0068
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* * *

Included with this Report is a map to our Atlanta offices. We welcome customer visits.

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PRICING

NATURAL URANIUM AND SECONDARY MARKET CONVERSION

The **Exchange Value** as of February 28, 1985 is **$15.00** per pound U_3O_8, unchanged since last month. **Active supply** of natural uranium (U_3O_8 and UF_6) for spot or near-term delivery totals **5,315,000** pounds U_3O_8 or equivalent UF_6, up 1,135,000 pounds since last month. The corresponding figure for **active demand** is **2,270,000** pounds, up 1,005,000 pounds. The spot and near-term **supply-demand ratio** fell to **2.3:1.**

The *Current Market Data* section of this Report lists nine natural uranium sales transactions, involving a total of approximately 2,100,000 pounds equivalent U_3O_8. Five of the transactions reported this month involved natural UF_6, eight involved deliveries before 1986, and six met the criteria for inclusion in the current Transaction Value calculation. In addition, two low-enriched uranium transactions are reported.

The **Transaction Value** as of February 28, 1985 is **$15.70** per pound U_3O_8, down $0.50 since last month. The current Transaction Value includes 13 transactions involving a total of 2.3 million pounds U_3O_8 or equivalent UF_6 and covers a period of 4 months. The Transaction Value fell as a result of the removal from the calculation of four months' transactions involving some one million pounds of uranium. Those transactions, most of which took place in the summer of 1984, involved higher prices consistent with the significantly higher Exchange Value ($17.50) in those months.

The **Loan Use Charge Rate** as of February 28, 1985 declined to **5 percent** per annum as a lender offered a substantial quantity of material at that rate.

* * *

The Exchange Value remained at $15.00 in a market characterized by a widening range of prices at which transactions take place. Some evidence suggested a price firming, yet several buyers still found material available at prices below $15.00. Other transactions were concluded at or well above $15.00. Continued seller resistance to substantially lowering prices, combined with a growing feeling among discretionary buyers that market prices had temporarily stabilized, led to increased buying activity and an active month for transactions, including nine sales of natural uranium. Although substantial quantities of natural uranium remain available, downward pressure on prices appears to have subsided, at least temporarily.

* * *

The **Conversion Value** is **$1.00** per pound U in UF_6, unchanged since last month. Two secondary market conversion transactions are reported, involving approximately 200,000 pounds U in UF_6. Active supply of secondary market conversion services for delivery within three years totals 300,000 pounds U as UF_6. Active secondary market demand for conversion amounts to 255,000 pounds U in UF_6.

ENRICHED URANIUM AND SWUS

The Nuexco **SWU Values** as of February 28, 1985 are:

1. For **DOE origin,** a tails assay of 0.30 weight-percent U_{235}, and certifiable as excess:
   a. For FY85 delivery, **$102** per SWU, down 10;
   b. For FY86 delivery, **$20** discount from the USEC base price on delivery (15 last month);
2. For **other** SWUs (includes DOE origin SWUs not certifiable as excess and non-DOE origin SWUs):
   a. For delivery in calendar year 1985, **$80** per SWU, unchanged;
   b. For delivery in calendar year 1986, **$88** per SWU, down 2.

One secondary market SWU transaction is reported, involving less than 50,000 SWUs.

* * *

The decline in price for DOE-origin, certifiable as excess SWUs for delivery in fiscal year 1985 reflects the minimal demand for FY85 material. Almost all supply has been depleted, and substantial discounts can be found. Nevertheless, the market remains open until DOE announces new FY86 prices, expected this month. Some sellers with FY85 and FY86 SWUs are concentrating their sales efforts on the FY86 market, where known demand exists. Sellers realize that they should sell quickly, since prices are likely to drop soon after DOE announces new prices, especially in light of DOE's announced intentions relative to incentive pricing. With several sellers competing actively, discounts for FY86 SWUs have increased slightly.

The market for other SWUs (non-DOE or DOE SWUs not certifiable as excess), while relatively dormant, has loosened slightly. Prices are dropping slowly as non-DOE suppliers try to match DOE incentive pricing. This applies to SWUs purchased for delivery in 1987 and beyond.

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PRICING

Nuexco's information indicates that the DOE incentive pricing initiative, although not public at press time, will be made available to all USEC customers with uncommitted requirements, including those customers that will reduce their 100-percent-of-requirements commitment to a 70-percent commitment as allowed under the USEC. DOE will send the offer to its customers in March, and customers will be required to respond within 45 days. It appears that FY87 and FY88 SWUs will be priced at $90 per SWU, while FY89 and FY90 SWUs will be priced at $90 per SWU, escalated. The escalated price for FY89 and FY90 material will follow the USEC escalation formula for FY87 SWUs. Utilities will be able to purchase incentive-priced SWU for the first two years, the first three years or all four years. The commitment must be made to DOE within the 45-day response period.

The DOE program depends on the acceptance of a certain percentage of customers, which is as yet unspecified. The effect of other terms contained in the USEC, such as the Variable Tails Assay Option (VTAO), will be determined depending on the response to the incentive plan. As in the case of the USEC itself, market reaction to DOE's sales efforts can still have an effect on the specific terms and conditions which will be made available to its customers.

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CURRENT MARKET DATA

February 28, 1985	Market Values	Active Supply[1] (thousands)	Active Demand[1] (thousands)
EXCHANGE VALUE	**$15.00**/lb. U_3O_8	5,315	2,270
CONVERSION VALUE	**$1.00**/lb. U in UF_6	300	255
SWU VALUES			
DOE origin, certifiable as excess, 0.3 tails assay			
FY85 delivery	**$102**/SWU		
FY86 delivery	**$20** discount/SWU		
Other SWUs (non-DOE or non-certifiable)			
calendar year 1985 delivery	**$80**/SWU		
calendar year 1986 delivery	**$88**/SWU		
LOAN USE CHARGE RATE	5%/annum	0	0

TRANSACTION VALUE

$/lb. U_3O_8	Millions of Pounds	Number of Transactions	Number of Months
15.70	2.3	13	4

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[1] Supply and demand tables in the *Current Market Data* section of this Report detail the numbers for each category.

DEFINITIONS

1. The **Exchange Value** is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the date indicated.
2. The **Conversion Value** is Nuexco's judgment of the price at which spot and near-term transactions for significant quantities of conversion services could be concluded in the secondary market as of the date indicated.
3. The **SWU Values** represent Nuexco's judgment of the price at which transactions for the sale of significant quantities of SWUs of stated origin for delivery in the specified time period could be concluded as of the date indicated.
4. The **Loan Use Charge Rate** is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the date indicated.
5. The **Transaction Value** is a weighted average price of recent natural uranium sales transactions. The calculation is based on prices paid in:
   a. Transactions closed within the previous three-month period for which delivery is scheduled within one year of the transaction date;
   b. At least ten transactions;
   c. Transactions involving a sum total of at least 2 million pounds U_3O_8 equivalent.

   The sample time is extended as necessary to include these minima. Other currencies are converted to US dollars using conversion rates in effect on or near the transaction date.

DERIVATIONS AND COMMENTS

1. All Market Values are based on:
   a. Data from recently completed transactions.
   b. Data from pending transactions.
   c. Firm bids to buy or borrow, and firm offers to sell or lend.
   d. Prices purchasers or rates borrowers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy or borrow, and prices sellers or rates lenders have expressed a willingness to offer, but for which Nuexco is not aware of firm offers to sell or lend.
2. Prices associated with deliveries under old or renegotiated contracts or other than arm's-length transactions are not considered in the determination of these Market Values.
3. In the determination of the Conversion Value, Nuexco does not consider transportation charges other than those customarily provided by primary suppliers of conversion services.
4. The prices of conversion services or SWUs delivered under long-term contracts with primary suppliers are not considered in the determination of either the Conversion Value or SWU Value.
5. For the DOE SWU Values, Nuexco converts SWU prices at varying tails and product assays to equivalent SWU prices at a tails assay of 0.30 weight-percent U_{235} and a product assay of 3.0 weight-percent U_{235}, assuming feed costs corresponding to the Nuexco Exchange and Conversion Values determined as of the same date.
6. In calculating the Transaction Value, Nuexco does not account for the price of uranium delivered in connection with contracts which call for "market price" mechanisms. This exclusion applies particularly to contracts in which delivery prices are expressed as a function of future Exchange Values or any other indeterminant variable. Also excluded from the calculation are any other transactions in which the delivery price is defined in such a way that it cannot currently be determined.

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CURRENT MARKET DATA

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb. U_3O_8 in Concentrates			per kg. U in Concentrates		
	This Month (Feb. 28, 1985)	Last Month (Jan. 31, 1985)	12 Months Ago (Feb. 29, 1984)	This Month (Feb. 28, 1985)	Last Month (Jan. 31, 1985)	12 Months Ago (Feb. 29, 1984)
Australia (dollar)	20.76	18.38	18.54	53.97	47.78	48.20
Belgium (comm. franc)	1,001	949.37	933	2,602	2,468	2,426
Canada (dollar)	20.73	19.91	21.89	53.89	51.77	56.91
Finland (markka)	103.38	99.40	98.65	268.76	258.43	256.46
France (franc)	152.39	145.07	140.00	396.19	377.14	363.97
FRG (mark)	49.85	47.53	45.50	129.60	123.56	118.29
Italy (lira)	30,902	29,240	28,262	80,339	76,017	73,476
Japan (yen)	3,881	3,817	4,084	10,090	9,923	10,618
Netherlands (guilder)	56.24	53.74	51.33	146.22	139.72	133.46
South Africa (rand)	30.00	29.56	21.02	77.99	76.84	54.65
Spain (peseta)	2,745	2,628	2,611	7,137	6,832	6,788
Sweden (krona)	140.71	135.62	135.98	365.82	352.59	353.50
Switzerland (franc)	42.37	40.11	37.82	110.16	104.27	98.33
UK (pound)	13.76	13.27	11.71	35.78	34.50	30.44
US (dollar)	15.00	15.00	17.50	39.00	39.00	45.50

TRANSACTION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb. U_3O_8 in Concentrates			per kg. U in Concentrates		
	This Month (Feb. 28, 1985)	Last Month (Jan. 31, 1985)	12 Months Ago (Feb. 29, 1984)	This Month (Feb. 28, 1985)	Last Month (Jan. 31, 1985)	12 Months Ago (Feb. 29, 1984)
Australia (dollar)	21.73	19.85	23.84	56.49	51.60	61.97
Belgium (comm. franc)	1,047	1,025	1,200	2,723	2,666	3,120
Canada (dollar)	21.70	21.51	28.15	56.41	55.91	73.17
Finland (markka)	108.20	107.36	126.83	281.30	279.10	329.73
France (franc)	159.50	156.67	180.00	414.68	407.31	467.96
FRG (mark)	52.18	51.33	58.50	135.65	133.45	152.09
Italy (lira)	32,344	31,579	36,337	84,088	82,098	94,469
Japan (yen)	4,062	4,122	5,251	10,561	10,717	13,651
Netherlands (guilder)	58.87	58.04	66.00	153.04	150.90	171.59
South Africa (rand)	31.40	31.92	27.03	81.63	82.99	70.26
Spain (peseta)	2,873	2,838	3,357	7,470	7,378	8,728
Sweden (krona)	147.28	146.47	174.83	382.89	380.80	454.51
Switzerland (franc)	44.35	43.32	48.63	115.30	112.61	126.42
UK (pound)	14.40	14.33	15.06	37.45	37.25	39.14
US (dollar)	15.70	16.20	22.50	40.82	42.12	58.50

[1] Calculated using currency exchange rates published in the *Wall Street Journal* on February 28, 1985.

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CONVERSION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

	per lb. U as UF₆			per kg. U as UF₆		
Country (currency)	This Month (Feb. 28, 1985)	Last Month (Jan. 31, 1985)	12 Months Ago (Feb. 29, 1984)	This Month (Feb. 28, 1985)	Last Month (Jan. 31, 1985)	12 Months Ago (Feb. 29, 1984)
Australia (dollar)	1.38	1.23	0.32	3.05	2.70	0.70
Belgium (comm. franc)	66.71	63.29	16.00	147.07	139.53	35.27
Canada (dollar)	1.38	1.33	0.38	3.05	2.93	0.83
Finland (markka)	6.89	6.63	1.69	15.19	14.61	3.73
France (franc)	10.16	9.67	2.40	22.40	21.32	5.29
FRG (mark)	3.32	3.17	0.78	7.33	6.99	1.72
Italy (lira)	2,060	1,949	484.50	4,542	4,298	1,068
Japan (yen)	258.73	254.45	70.01	570.41	560.97	154.35
Netherlands (guilder)	3.75	3.58	0.88	8.27	7.90	1.94
South Africa (rand)	2.00	1.97	0.36	4.41	4.34	0.79
Spain (peseta)	183.02	175.19	44.76	403.48	386.23	98.69
Sweden (krona)	9.38	9.04	2.33	20.68	19.93	5.14
Switzerland (franc)	2.82	2.67	0.65	6.23	5.89	1.43
UK (pound)	0.92	0.88	0.20	2.02	1.95	0.44
US (dollar)	1.00	1.00	0.30	2.20	2.20	0.66

SWU VALUES EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	DOE SWU FY85 (February 28, 1985)	Non-DOE SWU 1985 delivery (February 28, 1985)	Non-DOE SWU 1986 delivery (February 28, 1985)
Australia (dollar)	141.18	110.73	121.80
Belgium (comm. franc)	6,805	5,337	5,871
Canada (dollar)	140.96	110.56	121.61
Finland (markka)	702.96	551.34	606.48
France (franc)	1,036	812.76	894.04
FRG (mark)	338.98	265.87	292.46
Italy (lira)	210,136	164,813	181,294
Japan (yen)	26,391	20,699	22,768
Netherlands (guilder)	382.45	299.96	329.96
South Africa (rand)	204.00	160.00	176.00
Spain (peseta)	18,668	14,641	16,105
Sweden (krona)	956.85	750.47	825.52
Switzerland (franc)	288.14	225.99	248.59
UK (pound)	93.58	73.39	80.73
US (dollar)	102.00	80.00	88.00

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[1] Calculated using currency exchange rates published in the *Wall Street Journal* on February 28, 1985.

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CURRENT MARKET DATA

RECENT TRANSACTIONS[1]

Uranium Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U_3O_8 equivalent)	Approximate Price as Percent of Current E.V.	Seller	Buyer	Remarks
3335	1985	101-300	117	Canadian Producer	R[2]	UF_6.
3334	1985	101-300	R[2]	Trader	Trader	UF_6.
3333	1985	less than 50	96	US Producer	US Utility	
3331	1985	50-100	100	European Utility	R[2]	UF_6.
3330A	R[2]	less than 50	101	European Utility	R[2]	Contained in LEU.
3322A	1985	less than 50	105	Trader	European Utility	Contained in LEU.
3321	1985	50-100	less than 97	R[2]	European Utility	UF_6.
3320	1985	301-600	100	Trader	European Utility	UF_6.
3319	1985	101-300	105	US Producer	Far East Utility	
3318	1988-1992	601-1,000	see remarks	US Producer	US Utility	Occurred in late 1984. Price escalated from January 1985.
3306	1985	101-300	100	US Producer	Far East Utility	

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[1] Transactions listed are not limited to those in which Nuexco was involved, but also include others of which Nuexco is aware.

[2] The notation *R* means that Nuexco either does not know, or that Nuexco has restricted that information to protect client confidentiality.

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CURRENT MARKET DATA

RECENT TRANSACTIONS[1] *(continued)*

Secondary Market Conversion Services

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U equivalent)	Approximate Price as Percent of Current C.V.	Seller	Buyer	Remarks
3340	1985	50-100	93	US Utility	US Utility	
3332	1985	101-300	100	US Utility	Trader	

Enrichment Services
Secondary Market Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity[2] (thousands of SWUs)	Approximate Price[3] as Percent of Current SWU Value[4]	Seller Group	Buyer Group	SWU Origin	Remarks
3339	1985	less than 50	110	US Utility	US Fabricator	DOE	Tails assay 0.2%.
3330B	R[5]	less than 50	R[5]	European Utility	R[5]	R[5]	Contained in LEU.
3322B	1985	less than 50	113	Trader	European Utility	DOE	Contained in LEU.

[1] Transactions listed are not limited to those in which Nuexco was involved, but also include others of which Nuexco is aware.

[2] If tails assay is unknown [illegible] unspecified, Nuexco's calculation of SWU quantity assumes 0.30 w/o tails assay.

[3] Price is not normalized [illegible]0% tails assay.

[4] Refers to SWU Value that corresponds to SWUs included in transaction. When prices and SWU values are expressed as discounts (e.g., X dollars less than DOE's USEC base price at time of delivery), the percentage refers to the ratio of the *discounts*, not the ratio of the prices.

[5] The notation *R* means that Nuexco either does not know, or that Nuexco has restricted that information to protect client confidentiality.

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CURRENT MARKET DATA

URANIUM SUPPLY
(February 28, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Spot or Near-term[2]	Intermediate or Long-term	Remarks
Available for Sale:			
ACTIVE			
1575	500	500 per year	
1860	400	1,500 per year	
2038	1,000	1,000 per year	UF_6
2134	220	220 per year	1986-87
2288A	40	—	
2288B	295	—	UF_6
2389	200	—	
2392	35	—	UF_6
2499	15	—	
2538*	25	—	
2565	400	—	
2584	300	—	
2603	10	—	
2633*	1,800	—	
2650*	40	—	
2675*	35	—	UF_6
2263	—	500 per year	1985-90
2625*	—	250 per year	1987-89
2657	—	980	1986; UF_6
TOTAL:	5,315		
INACTIVE			
2191	125	—	UF_6
2275	150	—	
2335	275	—	
2336	250	250 per year	1985-94
2495	130	—	UF_6
2553	300	—	
2654*	250	250 per year	UF_6
0564	—	1,000 per year	1985-90
2271	—	500 per year	1985-88
2297	—	200 per year	1986-89
2368	—	250 per year	1987-90
2514	—	1,000 per year	
2574	—	500	UF_6
2670*	—	525	1987
TOTAL:	1,480		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.
Projects removed since last month: 2236, 2326, 2509, 2516, 2538A, 2569, 2664.

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CURRENT MARKET DATA

URANIUM DEMAND
(February 28, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Spot or Near-term[2]	Intermediate or Long-term	Remarks
Inquiries to Purchase:			
ACTIVE			
2419*	65	—	UF_6
2548	300	—	
2590*	225	—	U_3O_8 or UF_6
2636*	100	—	
2661*	260	260 per year	1986-87
2674*	1,000	—	
2676*	160	—	UF_6
2690	160	—	
2217	—	1,000 per year	1989-95
2442	—	4,000	1986-95
2507	—	600	1987-89
2540	—	400 per year	1989-94
2659*	—	320 per year	1988-91
TOTAL:	2,270		
INACTIVE			
2329	500	—	1985
2576	20	—	UF_6
1999	—	50 per year	1986-90
2244	—	350 per year	1987 on
2414	—	365	1987-88
2457B	—	650	1987
2586	—	300	1987
2643	—	150 per year	1987 on
TOTAL:	520		

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*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.
Projects removed since last month: 2457A, 2638.

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CURRENT MARKET DATA

LOAN SUPPLY AND DEMAND
(February 28, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Within 1 Year	Beyond 1 Year	Remarks
Available for Loan:			
INACTIVE			
1938	2,000	—	UF_6
2128	700	—	
2139	2,000	—	
2469A	800	—	
2483	550	—	
2667*	800	—	
TOTAL:	6,850		

No inquiries to borrow this month.

CONVERSION SUPPLY AND DEMAND
(February 28, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U as UF_6) Within 3 Years	Beyond 3 Years	Remarks
Available for Sale:			
ACTIVE			
2051*	300	—	
TOTAL:	300		
INACTIVE			
2438	500	250 per year	1986-87
2511	600	700	1986-90
TOTAL:	1,100		
Inquiries to Purchase:			
ACTIVE			
2419A*	55	—	
2602*	200	—	
TOTAL:	255		
INACTIVE			
2529*	225	—	
2587	285	—	
2644	—	475	1987 on
TOTAL:	510		

*New or revised since last month.

[1] Measured from the date of this Report.

Projects removed since last month: 2638A.

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SWU SUPPLY
(February 28, 1985)

	Delivery Period[1] (Thousands of SWUs)		
Nuexco Project Number	Spot or Near-term[2]	Intermediate or Long-term	Remarks
Available for Sale:			
ACTIVE			
2100	150	100 per year	
2583	50	—	
2624	100	—	
2631	150	—	
2633B	330	—	
2664*	150	—	
2285	—	300	
2359*	—	300	
2513	—	25	1986
2517	—	150	1986-89
2571	—	55	1987
2657A	—	175	1986
TOTAL:	930		
INACTIVE			
2164	25	—	
2689*	40	—	
2378	—	120	1988
2510	—	50	
2652*	—	25	1986
TOTAL:	65		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes SWUs deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2531, 2589, 2632.

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CURRENT MARKET DATA

SWU DEMAND
(February 28, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of SWUs) Spot or Near-term[2]	Delivery Period[1] (Thousands of SWUs) Intermediate or Long-term	Remarks
Inquiries to Purchase:			
ACTIVE			
2655	10	—	
2665	50	—	
2669*	50	—	
2519	—	30 per year	1987 on
2578	—	100	1986
2653	—	100	1986-90
2658	—	5	1986
2693*	—	100	1989-90
TOTAL:	110		
INACTIVE			
2543	25	25	1986
2585*	90	—	1986
2500	—	500	1987-90
2512	—	15 per year	1987 on
2595	—	50	1986
TOTAL:	115		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes SWUs deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2459, 2480, 2640, 2689A.

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ASSESSMENT OF TODAY'S URANIUM MARKET: STARTING TO COME OF AGE

by

James E. Vaughan
President, Nuexco

The following is a slightly edited version of a speech presented by Nuexco President Jim Vaughan to the Atomic Industrial Forum's Fuel Cycle Conference in New Orleans, Louisiana, on March 12, 1985.

Market Overview

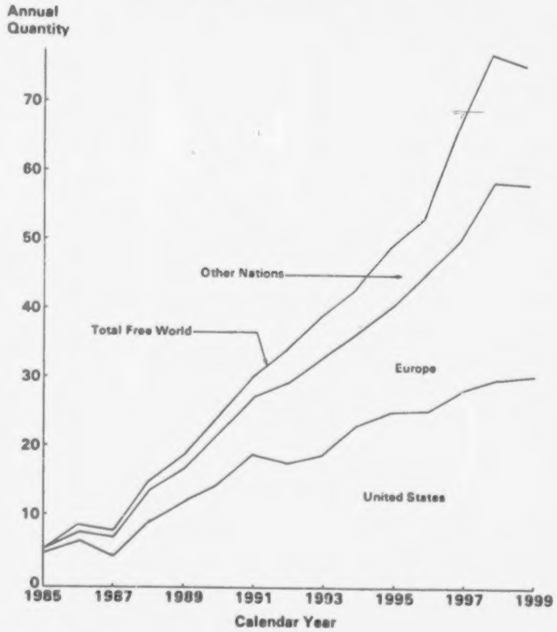
At first glance, the two big news items in the uranium market during the past year have been the USDOE's new contract, the Utility Services Enrichment Contract (USEC), and the definition of the Cigar Lake discovery in Saskatchewan. The USEC has been important news because it is a requirements-type contract which is replacing a fixed-commitment contract. Its near-term effect has been to weaken the uranium market because it has delayed the consumption of natural uranium (consumption for this purpose being defined as the introduction of uranium into the enrichment/fabrication "pipeline"). Eighteen months ago, Nuexco was forecasting substantial unfilled requirements beginning in the 1985-86 period. Now it appears that real unfulfilled requirements will not exceed ten million pounds U_3O_8 per year until 1988 (Figure 1).

The Cigar Lake deposit was the other big new items in 1984, although its only effect to date has been psychological. But markets react to psychological factors, and the announcement of such a huge deposit, estimated at 300 million pounds U_3O_8 at greater than ten-percent grade, has added to the already strong feeling that there is an ample supply of uranium in the world for many years to come. Moreover, the history of exploration suggests that Cigar Lake is probably not just one of a kind.

Later in this paper, other more subtle factors in the market will be discussed, in addition to these obvious points. In particular, we will examine the development of the spot market as it relates to the total market for uranium.

The Nuexco Exchange Value during 1984 dropped from US$20.50 in January to $15.25 in December, and it has dropped to $15.00 in 1985. In addition to Cigar Lake and the jolt of displaced consumption brought on by the USEC, the market continues to react to plant cancellations that have released or threaten to release large quantities of uranium into the spot and near-term markets. There have also been sales of marginal uranium production that are relatively price-insensitive. These factors were further exacerbated by the following influences:

FIGURE 1
FREE WORLD UNFILLED REQUIREMENTS
(Millions of Pounds U308 per Year)



1. The strong US dollar has had an effect on the market because uranium prices are normally quoted in US dollars in international transactions. The strong dollar in some cases has enabled non-US sellers to become more aggressive in pricing, since in recent months the US dollar has in general been rising faster than uranium prices have been falling.
2. World[1] uranium production has exceeded consumption by well over 25 million pounds U_3O_8 per year for the last five years. Production is expected to exceed consumption by nearly 20 million pounds in 1985.
3. In theory, world commercial inventories as of the end of 1984 are sufficient to meet all requirements through 1989 without any further production. That is, a five-year forward inventory now exists in the commercial uranium market. For comparison, world stocks of copper at present amount to only about three months' forward supply. The inventory situation is an important reason why movements in uranium prices, even spot prices, are relatively

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[1] World = WOCA (World Outside Centrally-planned economic Areas).

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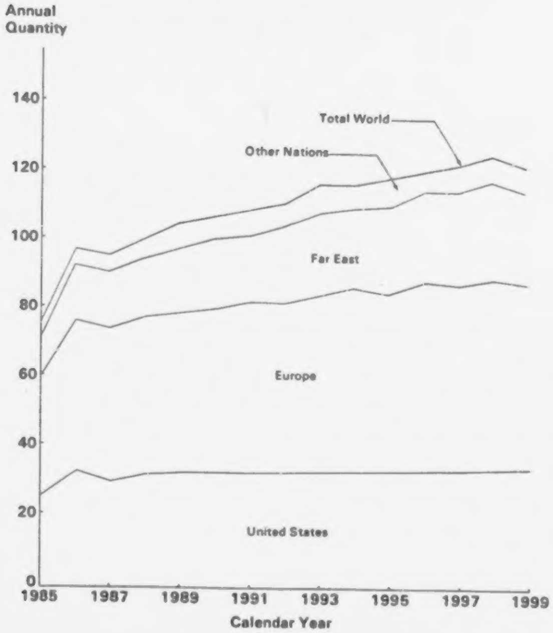
slow. Such price motion is dampened by the enormous inertia of the world stockpile. The outlook predicts a continued weak spot market for the next two or three years as real unfilled near-term requirements remain low, and secondary market activity is expected to remain high. The "secondary market" refers to new sales of uranium that previously has been sold; for example, the case of a utility selling off some of its inventory.

FIGURE 2
WORLD URANIUM CONSUMPTION
(Millions of Pounds U308 Equivalent)

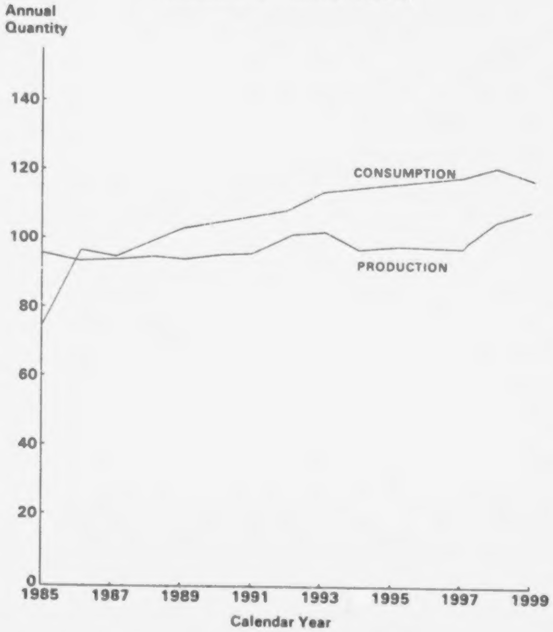


We do expect, however, that 1986 will bring the long-awaited crossover between consumption (Figure 2) and production (Figure 3). Nuexco forecasts 1986 world consumption at 97 million pounds U_3O_8, while production is expected to fall to 94 million pounds U_3O_8. Thus, beginning in 1986, we can expect to see the world inventory position gradually begin to decrease (Figure 4).

A Look at Pricing Concepts

Pricing trends are an aspect of the market that requires some examination of market data. Conventional belief has held that only a small fraction of uranium is traded at spot market prices; roughly five to ten percent is the amount often quoted. It is interesting to take a closer look at the market and the various types of transactions to see if this conventional idea is valid, and to forecast the direction that pricing concepts may be taking.

FIGURE 3
WORLD PRODUCTION COMPARED TO CONSUMPTION
(Millions of Pounds U308)



We arbitrarily decided to segregate the total 1984 uranium market deliveries into the following three pricing categories. The data includes sales of natural uranium concentrates (U_3O_8) and UF_6, as well as the natural uranium component in sales of enriched uranium:

1. Spot-related price;
2. Negotiated price;
3. Fixed price.

Contracts having spot-related prices include both simple spot contracts as well as longer-term contracts with pricing provisions directly related to the spot market (for example, by reference to the Nuexco Exchange Value). The negotiated price category includes long-term contracts containing provisions for the parties to meet periodically following contract signature to negotiate the price of a delivery or series of deliveries (for example, the great majority of deliveries to Japanese buyers). The fixed price category includes formula prices set forth in long-term contracts without any substantial reference in the formula to spot market indicators or negotiations. Cost-plus contracts and captive production are also included in this category.

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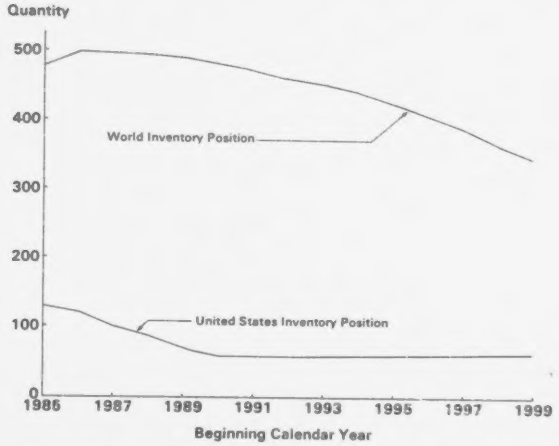
FIGURE 4
WORLD AND UNITED STATES INVENTORY POSITION
(Millions of Pounds U308 Equivalent)



In order to classify all 1984 deliveries into only three categories, some arbitrary decisions were necessary. Some contracts are easy to classify, such as simple spot sales or simple fixed long-term prices transactions, with or without formula escalation. Others are hybrids which include characteristics of more than one category. For example, some spot market price-related contracts contain floor price provisions. It was decided that in those cases where the floor price was substantially higher than the 1984 spot market price, the contract would be classified as fixed. If the floor price were of the order of the spot price level or lower, the contract would be classified as spot.

Table 1 contains a breakdown of the 1984 market resulting from this analysis. A total of 113 million pounds U_3O_8 equivalent was delivered in 1984 under 235 purchase-and-sale agreements. Of this amount, some 24 million pounds U_3O_8 (80 contracts) were delivered at spot market prices. A total of 26.5 million pounds U_3O_8 (33 contracts) was delivered under prices negotiated between the parties after the delivery contract was signed. The balance, 62 million pounds U_3O_8 (122 contracts), was delivered under formula prices, floor prices, or other arrangements not tied to a spot market indicator or annual negotiations. The percentages are as follows:

spot	21.1 percent
negotiated	23.5 percent
fixed	55.4 percent

The 1984 deliveries are further described in Table 2 by both production region and type of buyer. Total world estimated production in 1984 amounted to 99 million pounds U_3O_8. In a perfect market involving only producers, consumers and no intermediaries, and no secondary market or producer inventories, production would approximate deliveries. However, the uranium market is not perfect in that respect. Substantial secondary market activity has occurred in recent years, and producers add and subtract from inventory, including the practice of buying in the secondary market for redelivery. Thus, the additional deliveries in the latter group bring the 1984 total to 112.6 million pounds U_3O_8 equivalent, although most deliveries are in fact from producers to users.

The 24 million pounds traded at spot market prices in 1984 can be divided further as follows:

Transaction Type	Million pounds U_3O_8
1. Spot transactions	15.5
2. Longer term contracts having prices directly related to spot market indicators	8.3
TOTAL spot-related deliveries	23.8

A variation of the data in Table 1 is shown in Table 3. The objective of this variation is to determine the possible amount of material delivered at spot prices if the 1984 spot price level had been roughly double. This would neutralize the effect of most of the floor prices that placed many spot-related contracts in the "Fixed" category in Table 1. Under these different conditions, as indicated in Table 3, about 36 million pounds U_3O_8 would have been delivered at the spot price, an increase of 12 million pounds (50 percent). This 12 million pounds is the quantity of uranium now being delivered at fixed (floor) prices, material that would have been sold at spot prices had the spot market been considerably stronger.

In an effort to locate a trend, we performed a similar analysis to break down 1983 deliveries by pricing category. As indicated in Table 4, about 19.9 million pounds U_3O_8 equivalent (83 contracts) were delivered in 1983 at spot prices, or almost 20 percent of the total. With the results of this two-year analysis, plus the conventional belief that at one time only five to ten percent of uranium was traded at spot prices, one may infer a tendency toward the delivery of an increasing percentage of uranium at spot market prices. Table 5 contains a breakdown of 1983 data similar to Table 2.

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Table 1

1984 URANIUM DELIVERIES BY PRICING CATEGORY

(Millions of pounds U_3O_8 equivalent)

(number of contracts shown in parentheses)

Buyer Group	Fixed Price		Negotiated Price		Spot Price		Total Delivery to Buyer Group	
European User	22.7	(33)	8.4	(12)	4.7	(16)	35.8	(61)
US User	17.5	(43)	2.1	(2)	13.9	(43)	33.5	(88)
Other User	16.9	(40)	14.0	(18)	0.8	(3)	31.7	(61)
Non-User	5.2	(6)	2.0	(1)	4.4	(18)	11.6	(25)
TOTAL	62.3	(122)	26.5	(33)	23.8	(80)	112.6	(235)

Table 2

1984 URANIUM SELLERS' PRODUCTION AND DELIVERIES

(Millions of pounds U_3O_8 equivalent)

Region	1984 Production	Deliveries to Users	Deliveries to non-Users	Total Deliveries	Producer Inventory Additions[1]
Australia	10.3	8.6	0.0	8.6	1.7
Canada	27.9	25.3	2.7	28.0	(0.1)
France and Central Africa	19.0	14.9	0.5	15.4	3.6
Southern Africa	24.0	16.5	6.8	23.3	0.7
USA	15.6	24.8	1.0	25.8	(10.2)
Other Producers	2.2	1.7	0.2	1.9	0.3
Non-Producers	—	9.2	0.4	9.6	—
TOTAL	99.0	101.0	11.6	112.6	(4.0)

---

[1] Includes actual inventory changes and redeliveries within the year.

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A tendency toward increased use of the spot market, either directly or as a pricing method in long-term contracts, probably reflects the following factors:

1. A strong secondary market now exists.
2. The uranium market is coming of age. Buyers and sellers are becoming increasingly sophisticated and market information is more readily available to all participants. This maturity enables both buyers and sellers to have more confidence in the spot market.
3. There is strong pressure on some buyers, especially US utilities, to buy at spot-related prices, even under long-term contracts.

An Analogy to Another Commodity

Increasing market maturity, in the case of other commodities, has led to decreased dominance of producer (contract) prices. The aluminum market is a recent example of such a change. Through the early 1970s, the aluminum producers had fairly tight control over market prices, but the situation changed rapidly in the mid-1970s, and in late 1978, the London Metal Exchange (LME) finally introduced its first aluminum contract, based on a quoted LME spot price. Reasons for the change included:

1. The 1973-74 energy shock substantially boosted the smelting cost of some operators, especially in the USA.
2. New producers with lower production costs, chiefly lower energy costs, were then able to enter the market, causing dislocation of traditional supply channels.
3. A strong secondary market also developed in the 1970s. By 1984, an estimated 31 percent of Western World aluminum output was of secondary (recycled) origin.
4. The LME contract introduced in 1978 encouraged spot trading.

While we cannot carry the analogy too far for uranium because of the substantial differences between the two markets, there are a few indications which suggest a similar trend toward maturity in the uranium market:

1. A geopolitical shift in the uranium market is occurring, and new lower-cost uranium producers have become important, displacing some traditional supply channels.
2. A strong secondary uranium market has developed and shows signs of remaining strong.
3. At present there is no equivalent in uranium to the LME contract, but the universality of the "fuel adjustment clause" in the USA has been a strong independent driving force prompting US utilities to seek contracts with spot-market-related pricing provisions. Under the fuel adjustment clause, utilities can pass fuel costs directly through to customers, provided that the costs are reasonably and prudently incurred. Regulatory agencies generally have interpreted the "reasonable and prudent" provision to mean purchasing at about the level of spot market price in effect at the time of delivery. Thus, regulatory agencies generally allow purchases at spot market or less, but any increment above spot market usually must be absorbed by the utility.

Table 3

**1984 URANIUM DELIVERIES BY PRICING CATEGORY
WHERE "SPOT" INCLUDES DELIVERIES CURRENTLY "FIXED"
BECAUSE OF HIGH FLOOR PRICES**
(Millions of pounds U_3O_8 equivalent)
(number of contracts shown in parentheses)

Buyer Group	Fixed Price		Negotiated Price		Spot Price		Total Delivery to Buyer Group	
European User	18.3	(22)	8.4	(12)	9.1	(27)	35.8	(61)
US User	15.9	(38)	2.1	(2)	15.5	(48)	33.5	(88)
Other User	10.8	(32)	14.0	(18)	6.9	(11)	31.7	(61)
Non-User	5.2	(6)	2.0	(1)	4.4	(18)	11.6	(25)
TOTAL	50.2	(98)	26.5	(33)	35.9	(104)	112.6	(235)

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Conclusion

It remains to be seen if the present tendency toward increased use of the spot market will continue, but the forces appear to be working in that direction. Other commodities have endured similar transitions, and in a typical mature commodity market there is a very close relationship between the contract market and the spot market; indeed, they are often the same. For example, nearly all of the free world's copper production is sold at the LME (or another similar exchange) price at the time of delivery, whether it is sold under long-term or spot contracts.

In conclusion, it appears that the spot market has become an integral factor in the uranium market. Lessons from other commodities as well as driving forces present in the market today suggest that this tendency will continue.

Table 4

1983 URANIUM DELIVERIES BY PRICING CATEGORY
(Millions of pounds U_3O_8 equivalent)
(number of contracts shown in parentheses)

Buyer Group	Fixed Price		Negotiated Price		Spot Price		Total Delivery to Buyer Group	
European User	20.7	(32)	9.1	(13)	5.2	(13)	35.0	(58)
US User	19.7	(51)	1.5	(1)	7.0	(36)	28.2	(88)
Other User	16.5	(37)	13.8	(18)	0.6	(3)	30.7	(64)
Non-User	4.7	(6)	2.0	(1)	7.1	(31)	13.8	(38)
TOTAL	61.4	(132)	26.4	(33)	19.9	(83)	107.7	(248)

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Table 5

1983 URANIUM SELLERS' PRODUCTION AND DELIVERIES
(Millions of pounds U_3O_8 equivalent)

Region	1983 Production	Deliveries to Users	Deliveries to non-Users	Total Deliveries	Producer Inventory Additions[1]
Australia	8.4	9.6	0.0	9.6	(1.2)
Canada	18.9	20.1	1.4	21.5	(2.6)
France and Central Africa	20.0	14.5	0.3	14.8	5.2
Southern Africa	25.5	16.5	7.2	23.7	1.8
USA	21.2	25.3	1.8	27.1	(5.9)
Other Producers	1.7	1.0	0.5	1.5	0.2
Non-Producers	—	6.9	2.6	9.5	—
TOTAL	95.7	93.9	13.8	107.7	(2.5)

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[1] Includes actual inventory changes and redeliveries within the year.

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RECENT DEVELOPMENTS

CANADA

The partners of the Waterbury Lake Joint Venture have announced increased reserve estimates for the Cigar Lake uranium deposit. The mine is located in northern Saskatchewan, approximately 115 kilometers north of the Key Lake deposit. Estimates of the main mineralized pod indicate reserves of approximately 285 million pounds U_3O_8 (110,000 metric tons of uranium) at an average grade of 14 percent U_3O_8 (12 percent uranium). Additional inferred reserves at its western extension amount to approximately 100 million pounds U_3O_8 at an average grade of 4.7 percent U_3O_8. These estimates refer to in-place reserves; recoverable reserves are subject to the mining methods used.

Table 6

OWNERSHIP OF CIGAR LAKE

Company	**Percent Ownership**
SMDC[1]	50.75
Cogema Canada Ltd.	32.625
Idemitsu Uranium Exploration Canada Ltd.	12.875
Corona Grande[2]	3.75

[1] SMDC = Saskatchewan Mining Development Corporation.

[2] A wholly-owned subsidiary of Cogema Canada Limited.

Table 6 lists the ownership of the Cigar Lake venture. Cogema Canada, which has operated the Waterbury Lake Joint Venture since 1980, made the initial discovery in 1981. During 1983, 65 holes drilled on the primary structure were the basis of reserve estimates; new estimates based on drilling carried out through the end of 1984 surpass earlier expectations of size and ore grade.

Exploration work carried out to date includes a geostatistical estimation of the reserves in the main mineralization, which occurs as a flat lens, 1 to 20 meters thick, extending over a length of 650 meters. Average depth is 430 meters, and the main mineral association is uraninite/nickel-cobalt arsenides. In addition to the drilling program, various pre-development studies took place in 1984, focusing on geotechnical, metallurgical, and environmental aspects of the project.

Exploration drilling and development studies will continue in 1985. The Waterbury Lake Joint Venture partners plan to establish a joint operating corporation, the Cigar Lake Mining Corporation (CLMC), comprised of mining engineers, geotechnicians and environmental specialists assigned to the project from SMDC, Cogema Canada, and Idemitsu. CLMC plans to study the feasibility of the project for the next three to five years. Commercial development of the deposit probably will commence early in the 1990s.

UNITED STATES

House of Representatives members have introduced legislation that would restrict nuclear trade, including purchases of uranium, with South Africa. The House bills (HR 1133, 1135 and 1098) would restrict the exchange of nuclear technology with South Africa as well as the US import of uranium from that country. Two of the bills, introduced by Rep. Charles Rangel (D-N.Y.), would prohibit export of nuclear material, equipment, and technology, and the US Tariff Schedules would be amended to prohibit the importation of coal and uranium from South Africa or Namibia. A third bill, introduced by Del. Walter Fauntroy (D-D.C.), which would prohibit the importation of South African coal and uranium, also would prohibit exports to South Africa of nuclear goods or technology. In addition, the bill would prohibit new investments in South African businesses and the importation of Krugerrands.

Various arguments against nuclear trade with South Africa have been expressed in the Congressional Record and in letters from Congressmen to former DOE Secretary Donald Hodel. These arguments include the following:

- The objective of seeking new signatories to the Nonproliferation Treaty (NPT) might be jeopardized.
- Other African nations could drop their support for the NPT in response to such trade approvals. The loss of a nation or bloc of nations could seriously undermine the future of the treaty in addition to the success of the Nonproliferation Treaty Review Conference in September.
- US trade policy should favor signatories of the NPT to avoid the impression that the USA is indifferent to the NPT status of other nations.

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The issue of safeguarded material remains a central conflict between South Africa and the NPT, although South Africa has agreed to place its Valindaba enrichment plant under safeguards. No agreement has been reached regarding the pilot enrichment facility at Pelindaba. In February 1984, DOE suspended the Electricity Supply Commission of South Africa's (Escom) two enrichment contracts because of a lingering safeguards dispute. Escom had been unable to export enriched product from the USA because of certain provisions in the Nuclear Nonproliferation Act of 1978 which pertain to non-weapons states. The US State Department requested the suspension following an announcement by South Africa's Atomic Energy Corporation that it would require safeguards as a condition of exporting nuclear material or technology.

Hodel responded to the arguments, stating that progress has been made as a result of US dialogue with South Africa, and that the country has resumed discussions with the International Atomic Energy Agency (IAEA) concerning safeguards to the Valindaba enrichment facility. Bills similar to the ones introduced in Congress in February have appeared before, but have been largely unsuccessful. It is likely, considering the Reagan administration's stance of "constructive engagement" with South Africa, that the bills will fail to gain the necessary Congressional support.

* * *

Long Island Lighting Company's (LILCO) Shoreham nuclear power plant received NRC approval to begin low-power operation. The approval follows numerous hearings and discussions regarding the feasibility of the 820-MWe BWR. A low-power license has been pending since a special board to consider the NRC's procedure for licensing the plant was set up in early 1984. The plant's major opponents, Suffolk County and the State of New York, immediately requested a stay of the NRC order, filing a suit in the US Court of Appeals for the D.C. Circuit. In addition, an NRC appeal board is considering the opponents' appeal.

The plant has had a long history of problems and delays which has fueled public criticism. Heavy financial burdens remain the chief obstacle to commercial operation. In an effort to save money, LILCO withdrew as an 18-percent partner in Niagara Mohawk's Nine Mile Point Unit 2 nuclear plant in early 1984. (LILCO later reached an agreement with Niagara Mohawk to resolve the defaulted partnership.) Shortly thereafter, the utility omitted its common stock dividend and eliminated some jobs. In October 1984, an Atomic Safety and Licensing Board recommended a low-power license for Shoreham to help ease the utility's financial problems.

Furthermore, opponents of the plant contend that LILCO's emergency evacuation plan is inadequate, an issue which is under consideration in a state court. Opponents argued that low-power tests should be postponed until the court rules. LILCO's evacuation plan was approved by federal authorities but is opposed by Suffolk County; New York Governor Mario Cuomo supports the county's position. LILCO, on the other hand, filed a lawsuit against Suffolk County in June 1984, charging $4 billion in damages if the county is successful in keeping the plant from operating.

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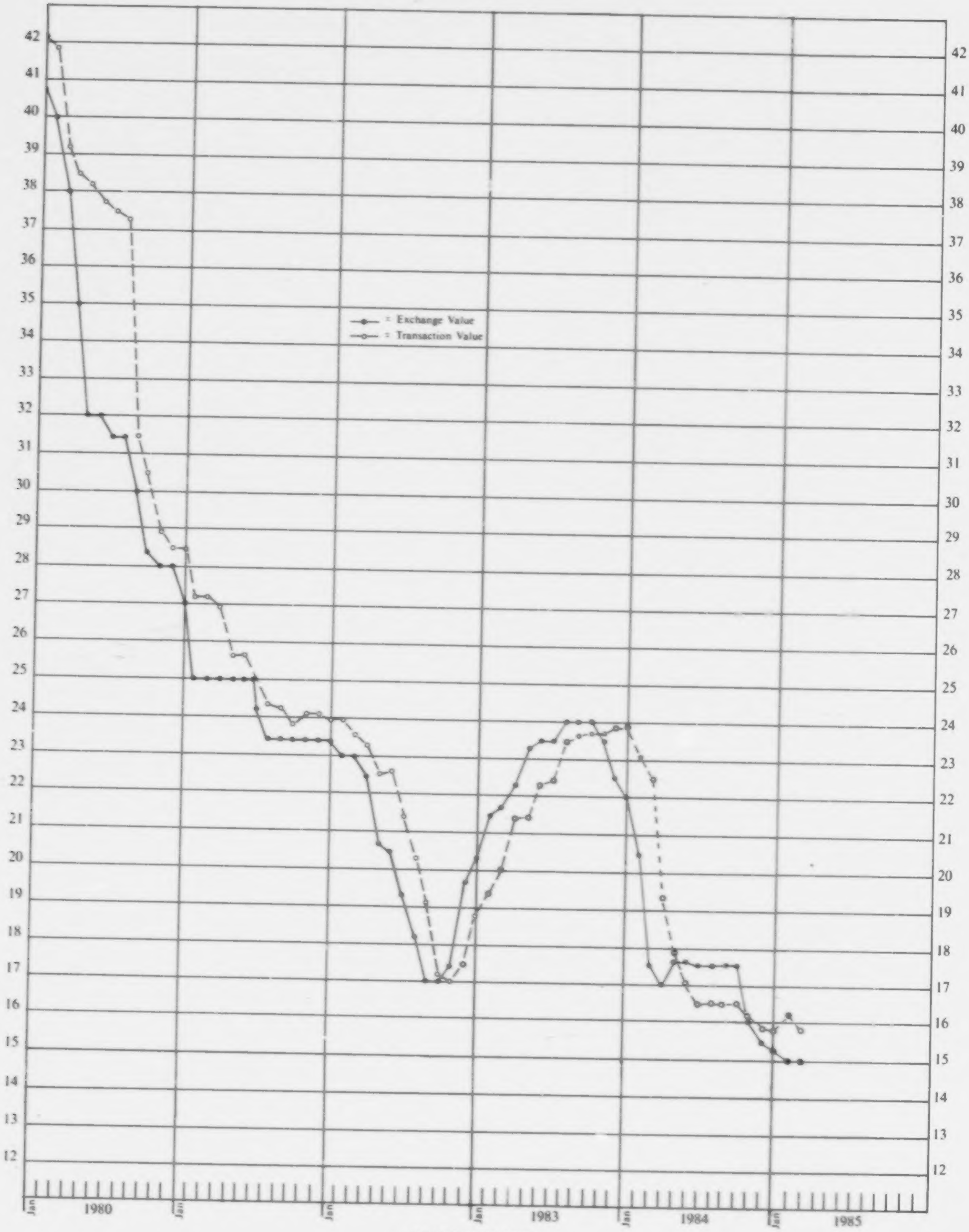
NUEXCO

HISTORICAL MARKET DATA

EXCHANGE AND TRANSACTION VALUES SINCE JANUARY 1980

Determined as of the last day of the month indicated



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HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	—	—	—	—	—	—	—	6.35	6.35	6.40	6.45	6.50
1969	—	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	32.50	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00
1981	25.00	25.00	25.00	25.00	25.00	24.25	23.50	23.50	23.50	23.50	23.50	23.50
1982	23.00	23.00	22.50	20.75	20.50	19.25	18.25	17.00	17.00	17.50	19.75	20.25
1983	21.50	21.75	22.25	23.25	23.50	23.50	24.00	24.00	24.00	23.50	22.50	22.00
1984	20.50	17.50	17.00	17.75	17.75	17.50	17.50	17.50	17.50	16.00	15.50	15.25
1985	15.00	**15.00**										

HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	—	—	—	—	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38.40	37.90	37.60	37.30	31.60	30.60	29.00	28.70	27.70
1981	27.20	27.20	27.00	25.70	25.70	24.50	24.40	24.30	23.90	24.10	24.10	24.00
1982	24.00	23.70	23.40	22.60	22.70	21.50	20.30	19.10	17.30	17.00	17.55	18.80
1983	19.35	20.00	21.35	21.40	22.35	22.45	23.50	23.60	23.65	23.65	23.85	23.85
1984	23.05	22.50	19.25	17.90	17.00	16.50	16.60	16.40	16.55	16.05	15.90	15.90
1985	16.20	**15.70**										

HISTORICAL CONVERSION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U as UF_6)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	1.20	1.20	1.20	1.40	1.15	1.15	1.15	1.10	1.10	1.10	1.20	1.20
1982	1.20	1.20	1.20	1.20	1.00	1.00	1.00	0.90	1.10	1.60	1.45	1.45
1983	1.20	1.40	1.40	1.20	1.20	1.20	1.10	1.10	1.00	0.60	0.60	0.60
1984	0.60	0.30	0.80	0.80	0.80	0.00	0.00	0.80	1.00	1.00	0.80	0.80
1985	1.00	**1.00**										

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GOVERNMENT STATISTICS

AUSTRALIA

	Price Index of Materials Used in Manufacturing Industry—All Groups[1] (1969=100)	Award Rates of Pay Indexes Australia—Adult Males In Mining Wage and Salary Earners, Weekly Rates[2] (1976=100)
1983 Avg.	401.2	181.8
Nov 1983	395.5	188.3
Dec 1983	399.2	188.1
Jan 1984	399.2	188.6
Feb 1984	402.5	188.5
Mar 1984	403.9	188.3
Apr 1984	404.2	196.2
May 1984	403.8	197.0
Jun 1984	404.9	197.0
Jul 1984	408.5	197.0
Aug 1984	413.3	197.0
Sep 1984	412.1	197.0
Oct 1984	408.6	197.0
Nov 1984	407.2	197.0
Dec 1984	—	197.0

P = Preliminary R = Revised since last month

CANADA

		Wage-earner Data: Average Hourly Earnings (C$)[2]					
	Industry Selling Price Index: Manufacturing[1] (1971=100)	Uranium Mines (SIC 057)	Metal Mines* (SIC 051-059)	Mines, Quarries and Oil Wells[3] (SIC 051-099)	Primary Metal Industries Non-ferrous[4] (SIC 296)	(SIC 298)	Chemicals and Chemical Products[5] (SIC 372-379)
1983 Avg.	298.8	—	—**	14.30	—	—	11.17
Jan 1984	305.4	17.74	15.27	14.74	11.91	10.84	11.69
Feb 1984	306.6	17.78	15.59	14.90	12.04	10.82	11.51
Mar 1984	308.7	18.05	15.52	14.82	12.14	10.84	11.58
Apr 1984	310.5	18.06	15.83	15.10	11.96	10.34	11.63
May 1984	310.6	18.46	15.64	15.06	12.11	10.16	11.65
Jun 1984	311.0	18.08	15.48	14.80	12.38	10.40	11.66
Jul 1984	312.7	17.81	15.72	14.92	12.53	10.18	11.82
Aug 1984	312.7R	17.24	15.36	14.92	12.44	10.34	11.78
Sep 1984	312.3R	17.68	15.96	15.34	12.51	10.52	11.90
Oct 1984	312.3	17.64	16.15	15.26	12.69	10.56	11.96
Nov 1984	313.6R	18.04R	16.13R	15.43R	12.47	10.51R	11.96R
Dec 1984	314.3R	17.96P	16.21P	15.57P	12.17P	10.45P	12.00P
Jan 1985	315.5P	—	—	—	—	—	—

P = Preliminary R = Revised since last month

For annual averages prior to 1983, and for notes pertaining to these statistics, see pages 23–26 of Report 190 of June 1984.

*The 1980 average for Metal Mines was incorrectly reported as 10.59. The correct average is 10.58 (see Report 190).

**Two different methods were used in the 1983 "Metal Mines" category in reporting survey data, and Statistics Canada did not publish a 1983 average. The March 1983 figure for the old method was 14.73 and for the new method was 14.84. The published average for 1983 in Report 190 was a Nuexco calculation based on the available monthly statistics for 1983 with the exception of the March figure, where only the 14.84 value was taken into account.

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GOVERNMENT STATISTICS

REPUBLIC OF SOUTH AFRICA

	Average Declared Working Costs per per Metric Ton of Gold Ore Milled (Rand)[1]	Tonnage-Weighted Index of Average Working Costs per Metric Ton of Gold Ore Milled (March 1982=100)[2]	Consumer Price Index[3] (1975=100)[4]	Producer Price Index All Groups[5] (1975=100)	Total Employment in Mining and Quarrying (Code 35)[6]	Total Salaries and Wages in Mining and Quarrying (1,000 Rand) (Code 40)[6]
1983 Avg.	51.87	115.0	262.2	274.8	696,579	3,644,772
Dec 1983	53.70	119.6	273.2	283.7	690,750	333,595
Jan 1984	—	—	274.7	283.3	689,807	326,619
Feb 1984	—	—	278.4	286.5	702,553	335,906
Mar 1984	55.30	123.1	281.9	288.0	715,628	342,332
Apr 1984	—	—	286.1	290.2	712,963	327,550
May 1984	—	—	288.3	292.6	710,040	327,937
Jun 1984	56.95	126.2	291.2	295.3	717,009	347,121
Jul 1984	—	—	295.1	296.0	717,121	369,964
Aug 1984	—	—	297.0	300.8	721,905	361,357
Sep 1984	60.64	133.2	299.9	304.1	721,470	359,218
Oct 1984	—	—	303.7	308.7	717,865	363,755
Nov 1984	—	—	307.4	312.8	717,396	369,771
Dec 1984	62.92	138.6	309.4	315.9	—	—
Jan 1985	—	—	177.1*	—	—	—

*The basis for calculation for this index has been revised to January 1980 = 100.

UNITED STATES

	Producer Price Index[1]		Consumer Price Index[2]	GNP Implicit Price Deflator[3]	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[4]			
	Industrial Commodities (1967=100)	All Commodities (1967=100)	(1967=100)	(1972=100)	Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)	Electric and Electronic Equipment (SIC 36)
1983 Avg.	315.8	303.1	298.4	215.63	12.57	13.43	10.59	8.65
Dec 1983	318.4	306.1	303.5	218.53	12.75	13.33	10.90	8.84
Jan 1984	319.1	308.0	305.2	—	12.67	13.38	10.91	8.88
Feb 1984	320.6	308.9	306.6	—	12.81	13.34	10.90	8.86
Mar 1984	321.9	311.0	307.3	220.58	12.85	13.33	10.95	8.88
Apr 1984	322.5	311.4	308.8	—	12.91	13.30	10.97	8.89
May 1984	323.3	311.7	309.7	—	12.99	13.37	11.02	8.89
Jun 1984	323.9	311.4	310.7	222.40	12.96	13.40	11.03	8.91
Jul 1984	324.0	312.0	311.7	—	13.02	13.36	11.12	8.95
Aug 1984	323.5	310.9	313.0	—	13.10	13.51	11.13	9.00
Sep 1984	322.3	309.5	314.5	224.57R	13.20	13.39	11.23	9.08
Oct 1984	323.2	309.4	315.3	—	13.23	13.53	11.32	9.09
Nov 1984	323.8	310.4	315.3	—	13.23	13.76	11.35	9.15
Dec 1984	323.0	309.9	315.5	226.10R	13.21	13.65	11.35	9.26
Jan 1985	323.2	309.8	316.1	—	—	—	11.37	9.33

P = Preliminary R = Revised since last month

For annual averages prior to 1983, and for notes pertaining to these statistics, see pages 23-26 of Report 190 of June 1984.

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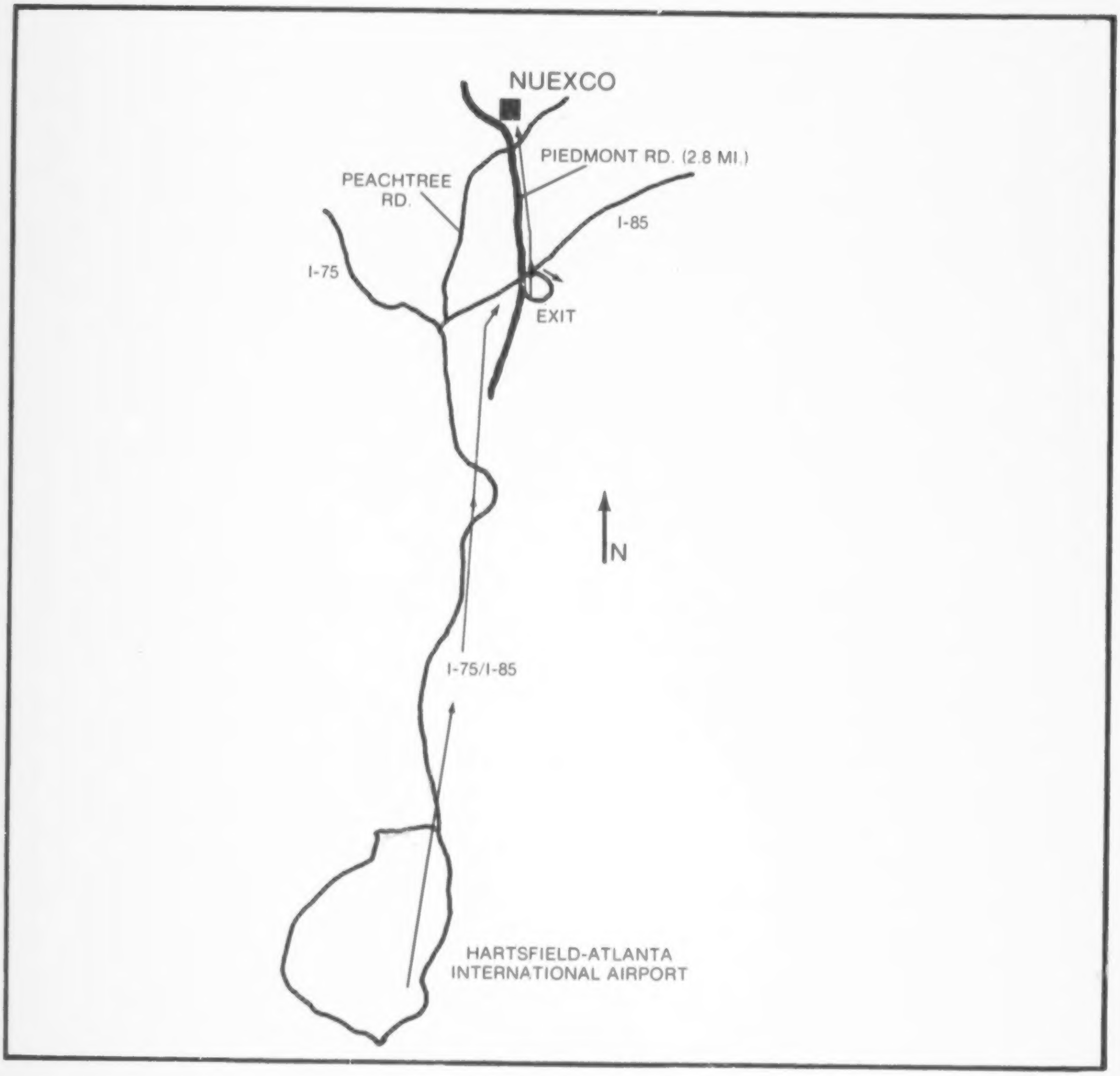
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EXECUTIVE SUMMARY
REPORT 199
(All data as of February 28, 1985)

Exchange Value
$15.00, unchanged

The **Exchange Value** is **$15.00** per pound U_3O_8, unchanged since last month. Nine recent natural uranium sales are reported, involving approximately 2.1 million pounds U_3O_8 equivalent. Eight involved delivery prior to 1986, and six met the conditions for inclusion in the Transaction Value. Two additional transactions, totaling less than 50 thousand pounds U_3O_8 equivalent, involved enriched uranium.

Supply-Demand Ratio
fell to 2.3:1

Active spot and near-term **uranium supply** amounts to **5.3 million** pounds U_3O_8 equivalent, up 1.1 million pounds since last month. Active spot and near-term **uranium demand** totals **2.3 million** pounds, up 1.0 million pounds. The spot and near-term **supply-demand ratio** declined to **2.3:1.**

Transaction Value
fell to $15.70

The **Transaction Value** is **$15.70** per pound U_3O_8, down $0.50 since last month. The calculation includes 13 transactions involving a total of 2.3 million pounds U_3O_8 and equivalent UF_6, and covers a period of 4 months.

Loan Use Charge Rate
declined to 5%

The **Loan Use Charge Rate** fell to **5 percent** per annum.

Conversion Value
unchanged at $1.00

The **Conversion Value** is **$1.00** per pound U as UF_6, unchanged since last month. Two secondary market conversion transactions are reported, involving approximately 200,000 pounds U as UF_6. Active secondary market supply for conversion services for delivery within three years totals 300 thousand pounds U as UF_6. Active demand totals 255 thousand pounds U as UF_6.

SWU Values:
$102 for DOE-origin (FY85)
$20 discount for FY86
$80 for non-DOE origin
calendar year 1985
$88 for calendar year 1986

The **SWU Values** for DOE origin at .3 tails and certifiable as excess, are **$102** per SWU for FY85 delivery, and **$20** per SWU discount from DOE base price for FY86 delivery. SWU Values for other SWUs (non-DOE or non-certifiable) are **$80** per SWU for calendar year 1985 delivery, and **$88** per SWU for calendar year 1986 delivery. One secondary market SWU transaction is reported, involving less than 50 thousand SWUs.

Analysis & Commentary

Nuexco President Jim Vaughan, in a speech given at the Atomic Industrial Forum's Fuel Cycle Conference, concluded that the spot market has become an integral factor in the uranium market and that this tendency probably will continue as the market matures.

Canada

The Waterbury Lake Joint Venture partners have announced increased reserve estimates for the Cigar Lake uranium deposit.

United States

Legislation introduced into the House of Representatives would prohibit the importation of uranium or coal from South Africa, and would also restrict other aspects of nuclear trade.

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NUEXCO REPORT 199 FIGURES OF THE MONTH (February 28, 1985)	This Month (Report 199)	Last Month (Report 198)	12 Months Ago (Report 187)
Exchange Value[1]	15.00	15.00	17.50
Transaction Value[1]	15.70	16.20	22.50
Loan Use Charge Rate[2]	5%	6%	6%
Conversion Value[3]	1.00	1.00	0.30
Near-Term Uranium Supply[4]	5.3	4.2	5.9
Near-Term Uranium Demand[5]	2.3	1.3	1.3
Near-Term Supply-Demand Ratio	2.3	3.3	4.5
Recent Uranium Sales:			
Number of Transactions[6]	9	1	4
Quantity of Material[7]	2.1	0.1-0.3	1.5-3.0
Nuexco SWU Values:[8]			
DOE origin, certifiable as excess, 0.3 tails assay			
FY85 delivery	102	112	—
FY86 delivery	20[9]	15[9]	—
Other SWUs (non-DOE or non-certifiable)			
1985 delivery	80	80	—
1986 delivery	88	90	—
USDOE SWU Prices:			
USEC	135.00	135.00	135.00
AFC	153.00[10]	153.00[10]	138.65
Requirements	157.00[10]	157.00[10]	149.85
Market Value of Enriched UF_6[11, 12]:			
2.5 w/o U_{235}	481	506	532
3.0 w/o U_{235}	621	656	685
3.5 w/o U_{235}	765	808	841
4.0 w/o U_{235}	911	964	999

---

[1] US $ per pound U_3O_8 equivalent.

[2] Per annum.

[3] US $ per pound U as UF_6.

[4] Active inquiries to sell, for delivery within 12 months after contract signing (millions of pounds U_3O_8).

[5] Active inquiries to purchase, for delivery within 12 months after contract signing (millions of pounds U_3O_8).

[6] Uranium sales only; does not include loans, conversion, or SWU transactions.

[7] Millions of pounds U_3O_8, equivalent.

[8] US $ per SWU.

[9] Discount from USEC base price on delivery.

[10] Effective 10/1/84.

[11] Calculated using the Nuexco Exchange Value, Conversion Value, and 0.30 percent tails assay. From 10/31/83 through 2/29/84, calculations used the Nuexco SWU Value for DOE origin and FY84 delivery. As of 3/31/84, calculations use the Nuexco SWU Value for DOE origin and FY85 delivery.

[12] US $ per KgU as UF_6, rounded to the nearest $.

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APRIL 1985

NUMBER 200

MONTHLY REPORT

ON THE NUCLEAR FUEL MARKET

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MONTHLY REPORT ON THE NUCLEAR FUEL MARKET
April 1985 No. 200

R. WESLEY MILLER, *EDITOR* CLARK M. BEYER, *ASSOCIATE EDITOR*

PRICING

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To Our Readers

Nuexco has just mailed a 1984 Annual Review to our full-service subscribers. This 54-page special report covers nuclear fuel market developments throughout the world in 1984 and early 1985. In particular, it analyzes the condition and pricing trends of the spot/near-term markets for uranium and secondary market enrichment services. Nuexco market values for 1984 have also been brought together in a series of tables for reference.

If you would like to purchase copies of the 1984 Annual Review Special Report, they are available for $175 each. Please contact our Headquarters:

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PRICING

NATURAL URANIUM AND SECONDARY MARKET CONVERSION

The **Exchange Value** as of March 31, 1985 is **$15.00** per pound U_3O_8, unchanged since last month. **Active supply** of natural uranium (U_3O_8 and UF_6) for spot or near-term delivery totals **4,250,000** pounds equivalent U_3O_8 as concentrates or UF_6, down 20 percent since last month. The corresponding figure for **active demand** is **4,055,000** pounds, up 80 percent. The spot and near-term **supply-demand ratio** fell to **1.0:1.**

The *Current Market Data* section of this Report lists eleven natural uranium sales transactions, involving a total of approximately 2,100,000 pounds equivalent U_3O_8. Three of the transactions reported this month involved natural UF_6, all involved deliveries before 1986, and ten met the criteria for inclusion in the current Transaction Value calculation.

The **Transaction Value** as of March 31, 1985 is **$15.05** per pound U_3O_8, down $0.65 since last month. The current Transaction Value includes 16 transactions involving a total of 2.4 million pounds U_3O_8 or equivalent UF_6 and covers a period of 3 months. The Transaction Value fell as a result of the large number of transactions added to the calculation this month, allowing the removal from the calculation of two months' transactions involving over one million pounds of uranium. Those transactions, most of which took place at the end of 1984, involved prices consistent with the slightly higher Exchange Values ($15.50 and $15.25) of those months.

The **Loan Use Charge Rate** as of March 31, 1985 is unchanged at **5 percent** per annum, as a lender continued to offer a substantial quantity of material at that rate.

* * *

The uranium market was unusually active in March. Transactions continued to take place slightly above and below the $15.00 level, and there were few indications of major price firming. Small quantities of material tended to command lower prices, but there was enough activity on both sides of the market to keep the Exchange Value temporarily stable. The heightened level of buyer interest has halted the slow decline of prices that was underway at the end of 1984.

* * *

The **Conversion Value** is **$1.00** per pound U in UF_6, unchanged since last month. One secondary market conversion transaction is reported, involving approximately 100,000 to 300,000 pounds U in UF_6. Active supply of secondary market conversion services for delivery within three years totals 110,000 pounds U as UF_6. Active secondary market demand for conversion amounts to 255,000 pounds U in UF_6.

It is becoming more and more difficult to characterize the secondary conversion market with only one price. Two distinctly different combinations of buyer-seller motivations are making two apparently conflicting types of pricing strategies necessary for the completion of transactions.

1. Sellers of natural UF_6 find it necessary to offer discounts of 25 to 35 percent (off the Nuexco Conversion Value) on the conversion component of their material in order to stimulate buyer interest.
2. Conversely, buyers that want secondary market conversion services (as opposed to UF_6) need to pay as much as a 50-percent premium (on the Nuexco Conversion Value) to attract a willing seller. Only one seller of conversion services is actively in the market at present, yet there are several buyers.

Thus, the conversion component contained in UF_6 is anywhere from one-half to three-fourths the value of conversion services purchased on the secondary market. That such apparently contradictory situations are present in the market is testimony to the degree of imperfection in the nuclear fuel market, imperfection which is most severe in conversion, the interface between U_3O_8 and UF_6. In theory, the value of UF_6 should be equal to the sum of its U_3O_8 and conversion components. However, under the present market conditions, that equality does not hold. In fact, UF_6 is worth *less than* the sum of its constituents. Hence the need for UF_6 sellers to discount conversion, while conversion buyers need to pay a premium.

ENRICHED URANIUM AND SWUS

The Nuexco **SWU Values** as of March 31, 1985 are:

1. For **DOE origin,** a tails assay of 0.30 weight-percent U_{235}, and certifiable as excess:
   a. For FY85 delivery, $98 per SWU, down 4;
   b. For FY86 delivery, $25 discount from the USEC base price on delivery (20 last month);
2. For **other** SWUs (includes DOE origin SWUs not certifiable as excess and non-DOE origin SWUs):
   a. For delivery in calendar year 1985, $80 per SWU, unchanged;
   b. For delivery in calendar year 1986, $85 per SWU, down 3.

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One secondary market SWU transaction is reported, involving approximately 300 to 600 thousand SWUs of Eurodif origin.

* * *

The continuing drop in the value for SWUs certifiable as excess for delivery in fiscal year 1985 reflects the almost complete lack of active demand for FY85 material. One active buyer remains, and the rest of the SWU demand has shifted to the FY86 market as it continues to develop. DOE's announcement of FY86 SWU prices is expected in the coming weeks. In the meantime, the DOE market remains glutted with sellers, applying downward pressure on prices. There is still little activity in Europe in the market for other SWUs (non-DOE or DOE SWUs not certifiable as excess). Buyers can expect prices to fall in response to DOE's offer of incentive prices for SWUs purchased for delivery in 1987 and beyond.

At the beginning of April, DOE sent letters to USEC customers proposing an incentive pricing program for enrichment. Responses in the form of bids are due April 30, 1985. Acceptance of the bids is contingent upon a large-enough response to make the program viable: perhaps as much as 2,000,000 SWUs. As reported in last month's pricing section (Report 199, March 1985), FY87 and FY88 SWUs will be priced at $90 per SWU (fixed), and FY89 and FY90 SWUs will be priced at $90 per SWU (escalated from October 1, 1988 according to the escalation formula specified in Article 4 of the USEC). Utilities will be able to purchase incentive-priced SWU for FY87-88 or for FY87-90. Other details are as follows:

1. The customer must commit to buy 100 percent of uncommitted requirements under the incentive pricing arrangement.
2. The customer may purchase more than 30 percent of requirements if that opportunity was created by a contract termination that occurred before December 31, 1983.
3. Less than 30 percent of requirements may be purchased if the opportunity to do so is a result of a contract agreed to before February 15, 1985.
4. The Variable Tails Assay Option (VTAO) may be selected between 0.2 and 0.3 percent by the utility *at no charge.* Presumably, the customer will be required to give notice according to the period established in the USEC. The customer may select only one tails assay per SWU order.

Because the utilities are required to bid to DOE, Nuexco expects that some customers will bid back different terms to DOE in order to obtain the best deal possible. It is not known whether DOE will extend the response period past the April 30 deadline.

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CURRENT MARKET DATA

March 31, 1985	Market Values	Active Supply[1] (thousands)	Active Demand[1] (thousands)
EXCHANGE VALUE	**$15.00**/lb. U_3O_8	4,250	4,055
CONVERSION VALUE	**$1.00**/lb. U in UF_6	110	255
SWU VALUES			
DOE origin, certifiable as excess, 0.3 tails assay			
FY85 delivery	**$98**/SWU		
FY86 delivery	**$25** discount/SWU		
Other SWUs (non-DOE or non-certifiable)			
calendar year 1985 delivery	**$80**/SWU		
calendar year 1986 delivery	**$85**/SWU		
LOAN USE CHARGE RATE	5%/annum	0	0

	$/lb. U_3O_8	Millions of Pounds	Number of Transactions	Number of Months
TRANSACTION VALUE	15.05	2.4	16	3

DEFINITIONS

1. The **Exchange Value** is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the date indicated.
2. The **Conversion Value** is Nuexco's judgment of the price at which spot and near-term transactions for significant quantities of conversion services could be concluded in the secondary market as of the date indicated.
3. The **SWU Values** represent Nuexco's judgment of the price at which transactions for the sale of significant quantities of SWUs of stated origin for delivery in the specified time period could be concluded as of the date indicated.
4. The **Loan Use Charge Rate** is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the date indicated.
5. The **Transaction Value** is a weighted average price of recent natural uranium sales transactions. The calculation is based on prices paid in:
   a. Transactions closed within the previous three-month period for which delivery is scheduled within one year of the transaction date;
   b. At least ten transactions;
   c. Transactions involving a sum total of at least 2 million pounds U_3O_8 equivalent.

   The sample time is extended as necessary to include these minima. Other currencies are converted to US dollars using conversion rates in effect on or near the transaction date.

DERIVATIONS AND COMMENTS

1. All Market Values are based on:
   a. Data from recently completed transactions.
   b. Data from pending transactions.
   c. Firm bids to buy or borrow, and firm offers to sell or lend.
   d. Prices purchasers or rates borrowers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy or borrow, and prices sellers or rates lenders have expressed a willingness to offer, but for which Nuexco is not aware of firm offers to sell or lend.
2. Prices associated with deliveries under old or renegotiated contracts or other than arm's-length transactions are not considered in the determination of these Market Values.
3. In the determination of the Conversion Value, Nuexco does not consider transportation charges other than those customarily provided by primary suppliers of conversion services.
4. The prices of conversion services or SWUs delivered under long-term contracts with primary suppliers are not considered in the determination of either the Conversion Value or SWU Value.
5. For the DOE SWU Values, Nuexco converts SWU prices at varying tails and product assays to equivalent SWU prices at a tails assay of 0.30 weight-percent U_{235} and a product assay of 3.0 weight-percent U_{235}, assuming feed costs corresponding to the Nuexco Exchange and Conversion Values determined as of the same date.
6. In calculating the Transaction Value, Nuexco does not account for the price of uranium delivered in connection with contracts which call for "market price" mechanisms. This exclusion applies particularly to contracts in which delivery prices are expressed as a function of future Exchange Values or any other indeterminant variable. Also excluded from the calculation are any other transactions in which the delivery price is defined in such a way that it cannot currently be determined.

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[1] Supply and demand tables in the *Current Market Data* section of this Report detail the numbers for each category.

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CURRENT MARKET DATA

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb. U_3O_8 in Concentrates This Month (Mar. 31, 1985)	per lb. U_3O_8 in Concentrates Last Month (Feb. 28, 1985)	per lb. U_3O_8 in Concentrates 12 Months Ago (Mar. 31, 1984)	per kg. U in Concentrates This Month (Mar. 31, 1985)	per kg. U in Concentrates Last Month (Feb. 28, 1985)	per kg. U in Concentrates 12 Months Ago (Mar. 31, 1984)
Australia (dollar)	21.28	20.76	18.12	55.31	53.97	47.11
Belgium (comm. franc)	940.44	1,001	905	2,445	2,602	2,353
Canada (dollar)	20.53	20.73	21.73	53.38	53.89	56.50
Finland (markka)	97.66	103.38	94.34	253.88	268.76	245.26
France (franc)	143.13	152.39	135.24	372.11	396.19	351.60
FRG (mark)	46.90	49.85	43.92	121.94	129.60	114.17
Italy (lira)	29,922	30,902	27,490	77,791	80,339	71,469
Japan (yen)	3,793	3,881	3,805	9,860	10,090	9,892
Netherlands (guilder)	52.80	56.24	49.53	137.26	146.22	128.78
South Africa (rand)	28.71	30.00	21.01	74.63	77.99	54.63
Spain (peseta)	2,610	2,745	2,518	6,786	7,137	6,547
Sweden (krona)	135.01	140.71	130.87	351.00	365.82	340.23
Switzerland (franc)	38.88	42.37	36.37	101.08	110.16	94.56
UK (pound)	12.20	13.76	11.71	31.72	35.78	30.43
US (dollar)	15.00	15.00	17.00	39.00	39.00	44.20

TRANSACTION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb. U_3O_8 in Concentrates This Month (Mar. 31, 1985)	per lb. U_3O_8 in Concentrates Last Month (Feb. 28, 1985)	per lb. U_3O_8 in Concentrates 12 Months Ago (Mar. 31, 1984)	per kg. U in Concentrates This Month (Mar. 31, 1985)	per kg. U in Concentrates Last Month (Feb. 28, 1985)	per kg. U in Concentrates 12 Months Ago (Mar. 31, 1984)
Australia (dollar)	21.35	21.73	20.52	55.50	56.49	53.34
Belgium (comm. franc)	943.57	1,047	1,025	2,453	2,723	2,665
Canada (dollar)	20.60	21.70	24.61	53.56	56.41	63.97
Finland (markka)	97.98	108.20	106.83	254.73	281.30	277.72
France (franc)	143.61	159.50	153.14	373.35	414.68	398.14
FRG (mark)	47.06	52.18	49.73	122.35	135.65	129.28
Italy (lira)	30,022	32,344	31,129	78,050	84,088	80,928
Japan (yen)	3,805	4,062	4,308	9,893	10,561	11,201
Netherlands (guilder)	52.97	58.87	56.09	137.72	153.04	145.82
South Africa (rand)	28.80	31.40	23.79	74.88	81.63	61.86
Spain (peseta)	2,619	2,873	2,851	6,808	7,470	7,413
Sweden (krona)	135.46	147.28	148.19	352.17	382.89	385.26
Switzerland (franc)	39.01	44.35	41.19	101.42	115.30	107.07
UK (pound)	12.24	14.40	13.26	31.82	37.45	34.46
US (dollar)	15.05	15.70	19.25	39.13	40.82	50.05

[1] Calculated using currency exchange rates published in the *Wall Street Journal* on March 29, 1985.

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CURRENT MARKET DATA

CONVERSION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

	per lb. U as UF_6			per kg. U as UF_6		
Country (currency)	**This Month (Mar. 31, 1985)**	**Last Month (Feb. 28, 1985)**	**12 Months Ago (Mar. 31, 1984)**	**This Month (Mar. 31, 1985)**	**Last Month (Feb. 28, 1985)**	**12 Months Ago (Mar. 31, 1984)**
Australia (dollar)	1.42	1.38	0.85	3.13	3.05	1.88
Belgium (comm. franc)	62.70	66.71	42.60	138.22	147.07	93.91
Canada (dollar)	1.37	1.38	1.02	3.02	3.05	2.25
Finland (markka)	6.51	6.89	4.44	14.35	15.19	9.79
France (franc)	9.54	10.16	6.36	21.04	22.40	14.03
FRG (mark)	3.13	3.32	2.07	6.89	7.33	4.56
Italy (lira)	1,995	2,060	1,294	4,398	4,542	2,852
Japan (yen)	252.84	258.73	179.05	557.43	570.41	394.74
Netherlands (guilder)	3.52	3.75	2.33	7.76	8.27	5.14
South Africa (rand)	1.91	2.00	0.99	4.22	4.41	2.18
Spain (peseta)	174.00	183.02	118.50	383.61	403.48	261.25
Sweden (krona)	9.00	9.38	6.16	19.84	20.68	13.58
Switzerland (franc)	2.59	2.82	1.71	5.71	6.23	3.77
UK (pound)	0.81	0.92	0.55	1.79	2.02	1.21
US (dollar)	1.00	1.00	0.80	2.20	2.20	1.76

SWU VALUES EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	**DOE SWU FY85 (March 31, 1985)**	**Non-DOE SWU 1985 delivery (March 31, 1985)**	**Non-DOE SWU 1986 delivery (March 31, 1985)**
Australia (dollar)	139.01	113.48	120.57
Belgium (comm. franc)	6,144	5,016	5,329
Canada (dollar)	134.15	109.51	116.36
Finland (markka)	638.02	520.83	553.39
France (franc)	935.11	763.36	811.07
FRG (mark)	306.44	250.16	265.79
Italy (lira)	195,492	159,585	169,559
Japan (yen)	24,779	20,228	21,492
Netherlands (guilder)	344.95	281.59	299.19
South Africa (rand)	187.56	153.11	162.68
Spain (peseta)	17,052	13,920	14,790
Sweden (krona)	882.09	720.07	765.08
Switzerland (franc)	254.02	207.36	220.32
UK (pound)	79.71	65.07	69.13
US (dollar)	98.00	80.00	85.00

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[1] Calculated using currency exchange rates published in the *Wall Street Journal* on March 29, 1985.

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CURRENT MARKET DATA

RECENT TRANSACTIONS[1]

Uranium Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U_3O_8 equivalent)	Approximate Price as Percent of Current E.V.	Seller	Buyer	Remarks
3381	1985	less than 50	100	US Producer	US Producer	
3380	1985	less than 50	98	US Producer	US Producer	
3371	1985	601-1,000	R[2]	US Utility	European Utility	UF_6. Inventory sale
3370	1985	301-600	93	US Utility	European Utility	UF_6. Inventory sale.
3369	1985	101-300	93	US Utility	US Utility	UF_6. Inventory sale.
3367	1985	less than 50	94	US Producer	US. Utility	
3364	1985	101-300	101	US Producer	US Producer	
3358	1985	301-600	98	US R[2]	US R[2]	
3356	1985	less than 50	97	US R[2]	US R[2]	
3346	1985	less than 50	94	Trader	US Utility	
3344	1985	less than 50	95	Trader	US Utility	

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[1] Transactions listed are not limited to those in which Nuexco was involved, but also include others of which Nuexco is aware.

[2] The notation *R* means that Nuexco either does not know, or that Nuexco has restricted that information to protect client confidentiality.

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RECENT TRANSACTIONS[1] *(continued)*

Secondary Market Conversion Services

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U equivalent)	Approximate Price as Percent of Current C.V.	Seller	Buyer	Remarks
3357	1985	101-300	65	R[5]	US Utility	

Enrichment Services
Secondary Market Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity[2] (thousands of SWUs)	Approximate Price[3] as Percent of Current SWU Value[4]	Seller Group	Buyer Group	SWU Origin	Remarks
3341	1986-1988	301-600	see remarks	European Entity	US Utility	Eurodif	Series of fixed prices.

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[1] Transactions listed are not limited to those in which Nuexco was involved, but also include others of which Nuexco is aware.

[2] If tails assay is unknown or unspecified, Nuexco's calculation of SWU quantity assumes 0.30 w/o tails assay.

[3] Price is not normalized to 0.30% tails assay.

[4] Refers to SWU Value that corresponds to SWUs included in transaction. When prices and SWU values are expressed as discounts (e.g., X dollars less than DOE's USEC base price at time of delivery), the percentage refers to the ratio of the *discounts*, not the ratio of the prices.

[5] The notation *R* means that Nuexco either does not know, or that Nuexco has restricted that information to protect client confidentiality.

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CURRENT MARKET DATA

URANIUM SUPPLY
(March 31, 1985)

	Delivery Period[1] (Thousands of Pounds U_3O_8)		
Nuexco Project Number	Spot or Near-term[2]	Intermediate or Long-term	Remarks
Available for Sale:			
ACTIVE			
1575	500	500 per year	
1860	400	1,500 per year	
2134	220	220 per year	1986-87
2389	200	—	
2392	35	—	UF_6
2538*	15	—	
2565	400	—	
2574*	640	—	
2584*	5	—	
2633	1,800	—	
2675	35	—	UF_6
2263	—	500 per year	1985-90
2625	—	250 per year	1987-89
2657	—	980	1986; UF_6
2680*	—	250 per year	1986-92
TOTAL:	4,250		
INACTIVE			
2191	125	—	UF_6
2275*	170	—	
2335	275	—	
2336	250	250 per year	1985-94
2495	130	—	UF_6
2553	300	—	
2654*	250	250 per year	UF_6
2271	—	500 per year	1985-88
2297	—	200 per year	1986-89
2368	—	250 per year	1987-90
2670	—	525	1987
TOTAL:	1,500		

* New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes materiai deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 0564, 2038, 2288A, 2288B, 2499, 2514, 2603, 2650.

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URANIUM DEMAND
(March 31, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Spot or Near-term[2]	Intermediate or Long-term	Remarks
Inquiries to Purchase:			
ACTIVE			
2419*	130	—	UF_6
2548*	290	—	
2574B*	640	—	UF_6
2590*	75	—	U_3O_8 or UF_6
2636	100	—	
2659*	250	—	
2661	260	260 per year	1986-87
2674*	800	—	
2676*	100	—	UF_6
2690	160	—	
2995*	1,250	—	UF_6
2217	—	1,000 per year	1989-95
2442	—	4,000	1986-95
2507	—	600	1987-89
2540	—	400 per year	1989-94
2611*	—	130 per year	1987-88
2681*	—	1,000 per year	1987-88
2694*	—	625	1987; UF_6
TOTAL:	4,055		
INACTIVE			
2576	20	—	UF_6
2244	—	350 per year	1987 on
2414	—	365	1987-88
2457B	—	650	1987
2586	—	300	1987
2643	—	150 per year	1987 on
TOTAL:	20		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 1999, 2329.

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CURRENT MARKET DATA

LOAN SUPPLY AND DEMAND
(March 31, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Within 1 Year	 Beyond 1 Year	Remarks
Available for Loan:			
INACTIVE			
1938	2,000	—	UF_6
2128	700	—	
2139	2,000	—	
2469A	800	—	
2483	550	—	
2667	800	—	
TOTAL:	6,850		

CONVERSION SUPPLY AND DEMAND
(March 31, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U as UF_6) Within 3 Years	 Beyond 3 Years	Remarks
Available for Sale:			
ACTIVE			
2051*	110	—	
TOTAL:	110		
INACTIVE			
2438	500	250 per year	1986-87
2511	600	700	1986-90
TOTAL:	1,100		
Inquiries to Purchase:			
ACTIVE			
2419A	55	—	
2602	200	—	
2617*	—	275	1986-91
TOTAL:	255		
INACTIVE			
2529	225	—	
2587*	70	—	
2644	—	475	1987 on
TOTAL:	295		

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* New or revised since last month

[1] Measured from the date of this Report

Projects removed since last month: None

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SWU SUPPLY
(March 31, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of SWUs) Spot or Near-term[2]	Intermediate or Long-term	Remarks
Available for Sale:			
ACTIVE			
2100	150	100 per year	
2359*	—	200	
2624	100	—	
2631	150	—	
2633B	330	—	
2664	150	—	
2285	—	300	
2513	—	25	1986
2517*	—	155	1986-89
2571	—	55	1987
TOTAL:	880		
INACTIVE			
2164*	20	—	
2378	—	120	1988
2510	—	50	
2652	—	25	1986
TOTAL:	20		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes SWUs deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2583, 2657A, 2689

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CURRENT MARKET DATA

SWU DEMAND
(March 31, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of SWUs) Spot or Near-term[2]	Intermediate or Long-term	Remarks
Inquiries to Purchase:			
ACTIVE			
2655	10	—	
2400*	—	150	1987-90
2519	—	30 per year	1987 on
2578	—	100	1986
2653	—	100	1986-90
2658	—	5	1986
TOTAL:	10		
INACTIVE			
2543	25	25	1986
2585*	—	40	1986
2500*	—	170	1988
2512	—	15 per year	1987 on
2595	—	50	1986
2693*	—	100 per year	1989-90
TOTAL:	25		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes SWUs deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2665, 2669.

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PRIVATIZATION AND THE COMPETITIVENESS OF US ENRICHMENT SERVICES

by Dr. Karl P. Cohen

The following is a presentation made by Dr. Karl Cohen at the Atomic Industrial Forum's Fuel Cycle Conference in New Orleans on March 13, 1985. Dr. Cohen's distinguished record in the field of nuclear energy includes major contributions to the theory of isotope separation and the methodology of gaseous diffusion and centrifugal separation. He received the 1979 Chemical Pioneer Award of the American Institute of Chemists for his theory of gas centrifuges. This presentation is reprinted by permission.

Introduction

In 1973, the US nuclear power program was projected to attain 1,200 GWe by the turn of the century. It is now projected to reach only 110 GWe (Table 1). The uranium enrichment industry, which presently has little other purpose than to supply fuel for nuclear power plants, must obviously be profoundly affected. We are not looking here at minor changes, which might be accommodated by a change in style of doing business, however desirable that might be. We are looking at order-of-magnitude changes. We are looking at an earthquake. What is called for is a complete reappraisal of the fundamental purposes and structure of the US uranium enrichment program, including our objectives in serving the domestic and international uranium enrichment markets by a government-managed enterprise.

Table 1

US ENRICHMENT ENTERPRISE CAPACITIES[1]
(Millions of SWUs per year)

	1973	1985
Capacity	17	27
Planned Capacity	10	13
Production	10	10
Projected domestic market in the year 2000	100	12
Projected off-shore market in the year 2000	100	30
Off-shore market share in percent	100	37

[1] Free World only.

You will have recognized that this call for a reappraisal of the goals of our enrichment program bears some resemblance to the conclusion of the Comptroller General in his recent report to former Congressman Ottinger on the new Utility Services Contract. There are however significant differences. I do not consider it *a priori* evident that serving the international market should be a primary objective, that pricing by itself will be sufficient to achieve it.

At present, fuel accounts for 20 to 30 percent of the generating cost of nuclear power (the lower value is in the USA, where capital costs are high). About one-third of this cost comes from the enrichment process. Thus enrichment contributes only 7 to 10 percent of nuclear power costs, while capital charges account for 50 to 70 percent. To a plant owner, assurance of supply of enriched uranium has five to ten times the economic weight as the price of enrichment itself. But the supply of enriched uranium from the USA is conditional on political concessions which are not only burdensome but subject to unilateral change. This has made the USA the enrichment supplier of last resort in the only market which still has vitality—the off-shore market. To breathe new life into the US enrichment enterprise we shall have to look at more than the technology, and more than the price. We shall have to examine some of the unwanted side-effects of that sacred cow of American politics, the nuclear non-proliferation policy.

The parallel between the difficulties of the enrichment enterprise and the difficulties of the US nuclear power industry has certainly not escaped this audience. The recent Forbes article concludes that a reform of our institutions, more than of our technology, is the prerequisite for a rebirth of the nuclear option in the US. Similarly, important as technology is in uranium enrichment, a purely technological fix is not available to us. We have to take into account the management of the enterprise, and the policies and institutions which constrain it.

Let me refer you back for a moment to the data in Table 1. It is clear that a pricing formula which might be perfectly reasonable in 1973 could be wildly inappropriate in 1985. The GAO letter, and the Congressional inquiry which precipitated it, illustrate, if further illustration were necessary, the intrinsic difficulties of government management of uranium enrichment, and the desirability of serious consideration of privatization.

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Objectives

Table 2 presents a number of possible objectives for the enrichment enterprise. At first glance, it might seem that all the objectives are desirable, and that all can be attained. However, this is only possible in a monopoly situation. For example, the virtue of the first objective, assuring domestic fuel supply, seems almost self-evident. It is a parallel to the requirement of the Atomic Energy Act that a viable domestic uranium industry be maintained. But other countries, many of whom have a far greater percentage commitment to nuclear electricity than we do, are likely to think the same way. If we are prepared to pay more for uranium from low-grade American ore, will they not be willing to buy enrichment services from their local enrichers, even at a premium? Assurance of supply by supporting domestic producers is a doctrine which, if adopted universally, is likely to frustrate the achievement of Objective 4. The continued interest in new enrichment programs—for example, Japan, Brazil, South Africa and Argentina—despite the world glut of separation capacity and overhanging enrichment inventories, points in this direction.

Table 2

POSSIBLE ENRICHMENT ENTERPRISE OBJECTIVES

1. Assure fuel supply for domestic reactors.
2. Maintain capability to produce HEU for military.
3. Maximize off-shore sales of reactor equipment by advantageous terms for enriched fuel.
4. Maximize off-shore market by low prices to support US non-proliferation policy.
5. Maximize market share by low prices to increase cash return.
6. Maximize profit.

The second objective introduces two new questions. The first is whether the production of HEU should ever be privatized. This might be resolved by splitting out the high enrichment cascade from the rest of the plant and retaining it as a separate, government-owned entity. This leads naturally to the issue of whether a privatized enrichment enterprise should be in one piece or split into several. Arguing for one piece are the extraordinarily high capital requirements of enrichment plants, capital which could be raised on most favorable terms by a regulated monopoly. A regulated monopoly could write long-term exclusive contracts, also helpful in raising capital, without running afoul of the anti-trust laws. Arguing for several pieces are the benefits of competition, and the relative ease of introduction of new technology.

The last four objectives are somewhat inconsistent, since it is unlikely that one can maximize them simultaneously. During the period of American monopoly of uranium enrichment facilities, maximizing off-shore sales of nuclear reactors and supporting US non-proliferation policy were not obviously incompatible. However, American supply of enriched uranium was accompanied by restrictions on use or disposal of the spent fuel. These were not acceptable to the Europeans, and were a determining factor in our ultimate loss of the enrichment monopoly. The passage of the Nuclear Non-Proliferation Act of 1978, which contains clauses encouraging the use of solar and renewable energy rather than nuclear power, and discouraging the reprocessing and recycling of spent nuclear fuel, has effectively eliminated the third objective. Nobody can possibly believe that the object of the coalition that passed the Act was to foster nuclear power in any country. The present policy of DOE is a combination of objectives 4 and 5, namely, maximizing the market share by lowering prices, to increase cash flow and also to support US non-proliferation policy. Increasing cash flow is the driving force. Supporting non-proliferation policy is a constraint. It should be noted that the erosion of the US off-shore market share began *before* the rise of the dollar, while we still had price leadership. Thus the policy seems unlikely to succeed without ruinous price concessions. It reminds me of the legendary wholesaler who lost on each sale, but made it up on volume.

The last objective is maximizing profit. Unless this is taken as the primary objective, privatization is only a slogan, not a real option. Maximizing profit might require a very different approach to the market. The approach might be to set terms and prices to suit the domestic market (where there is a preference for US supply), rather than to obtain the maximum off-shore market; to shut down and write off excessive and high cost production facilities; to evaluate technical options on a total cost and not a forward cost basis; to control costs by eliminating excessive contractors and excessive personnel; and to share the benefits of lower cost advanced technologies by improving profits as well as lowering prices. Such an approach would require unified marketing, but could in the long run accommodate competitive producing units.

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Further Observations on Privatization

The current invitation of DOE for private industry to invest in the AGC and the AVLIS processes is directed at solving DOE's immediate financial problem without altering the Department's management of the projects. The capital intensity of uranium enrichment is unusually great. The government is in fact the appropriate source of capital or credit. The financial problem has arisen by a combination of delayed management response to the rapidly changing market conditions, and hostile Congressional oversight. Industry has no place volunteering to be the lender of last resort, merely because ideologues in and out of Congress impose unreasonable constraints on the finances and the policies of the enrichment enterprise.

What should be privatized is not the *financing*, but the *management* of the uranium enrichment enterprise. This Administration, (and previous ones as well), have favored this procedure for organizations as diverse as the Post Office, the Federal National Mortgage Association, and the Tennessee Valley Authority.

The last major effort at privatization of enrichment peaked in the period 1975-76 with the debate on (and defeat of) the Nuclear Fuel Assurance Bill. At the time, the late Craig Hosmer suggested that a government corporation would be a more acceptable alternative. I believe his idea has considerable merit. Such a corporation would isolate the enrichment enterprise from the annual Congressional budget process. It could offer bonds like TVA, and allow investment to be offered based on the needs, and supported by the revenues, of the enrichment business alone. The Board of Directors should be larger than that of TVA, and include outside directors who would represent the insights and interests of other segments of the nuclear industry, notably (but not exclusively) the utilities and the uranium miners.

To establish such a corporation, new legislation would be necessary. The debate on such legislation would furnish an opportunity to forge a consensus on the *objectives* as well as the *structure* of the corporation, and might be an important step in the public education needed for a rebirth of the nuclear industry.

The Economic Competition

Economic comparisons between plants in different countries are very hazardous. Plant capital costs, even if fully reported, are in different currencies. Inflation and interest during construction depend on local circumstances and schedules. They are not strictly comparable, and they are seldom fully reported. The capital charge rate applied depends on details of the financing, generally considered a commercial secret, and the local accounting rules. In the US enrichment plants, the capital charge is the imputed interest rate, which rises and falls from year to year with general interest rates. Inventories of natural and enriched uranium may be large or small, depending on policy and history. The inventories may be valued at acquisition costs (themselves variable), or otherwise. The cost of maintaining inventory may be calculated in the same way as the cost of fixed capital, or differently. Finally the utilization factor—the fraction of the plant capacity which is actually used—is an overall divisor into the capital charges.

Of the operating costs, labor rates and productivity vary from one country to the next. In the gaseous diffusion process, the pricing formulae reveal that half the price is proportional to the cost of power. The power costs depend on contract arrangements with particular suppliers, whose demand and energy charges are not uniform. While these are published in the US, they are not readily available elsewhere. Plant managers, depending on production requirements, may schedule operations at off-peak hours, thus obtaining better rates. Thus, Eurodif plans to operate only during the seven summer months when power costs are lower.

Translating costs from one currency to another introduces another uncontrollable factor. Over the past four years the dollar has risen approximately 40 percent against a basket of 15 foreign currencies, and even more spectacularly—150 percent—against the French franc. Most observers believe the dollar is at a cyclical high and will come down. I do not know of any accepted economic theory which defines "equilibrium" exchange rates, but it seems unlikely that the dollar will fall below its 1980-81 values, when it was at a cyclical low. In most of the economic comparisons, I use the low values, to show that our present lack of cost and price leadership will not disappear with the next exchange rate fluctuation.

It is clear that the long-range competitiveness of the US Gaseous Diffusion Plant is not determined by the temporary embarrassment of an unfortunate power contract which imposes high demand charges for power not used. Just as clearly, it cannot be measured by the price of a particular block of kWh purchased over a summer weekend. We must bring in more fundamental considerations. What appears to be really relevant is the average bus-bar cost of electric energy to all US industry. We must face the fact that the US utility industry has fallen behind the rest of the world in its ability to build new capacity economi-

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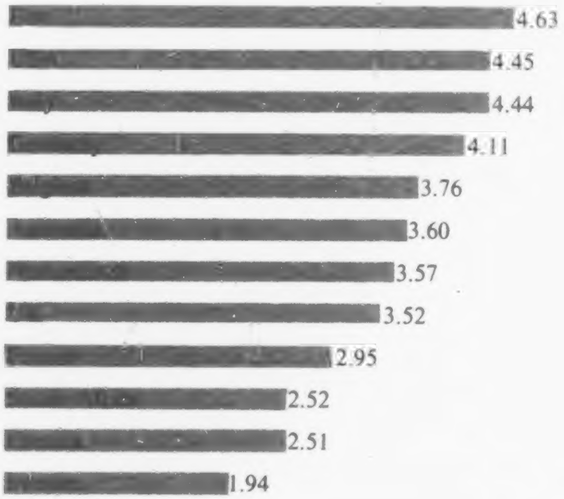
cally. The capital costs of any new generating capacity are so high that we are witnessing a virtual moratorium on new plant construction. In a situation where new capacity costs more than installed capacity, lower prices to one industry mean higher prices and less competitiveness for another.

When push comes to shove, the ultimate measure of competitiveness of gaseous diffusion plants will be their out-of-pocket costs for additional SWUs. Figure 1 shows the situation as of April 1, 1984. Eurodif uses about 13% more kWhs per SWU than our plants, but our kWhs cost about 50 percent more than theirs. Table 3 looks further ahead to 1990. Notice that the French total power cost is projected to be two-thirds of ours and their energy cost one-half, using 1981 exchange rates. In 1981, the franc was about 20 cents. The bottom line is my speculation on the generating costs of a Siberian hydro plant which would be feeding current to a Russian diffusion plant. The conclusion seems inescapable that our superior diffusion technology is not enough to compensate for the difficulties of our power industry. We will not regain price leadership with an energy-intensive process.

Figure 1

WORLD INDUSTRIAL AND COMMERCIAL ELECTRICITY PRICES AS OF APRIL 1, 1984[1]
(Pence per kilowatt-hour)



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[1] This figure is a reproduction of a figure presented in *Nuclear Europe*, Volume 10, October 1984, in an article by G. Ekberg, L. Fogelstrom and L. Gustafsson entitled "Nuclear Power Production in Sweden." Source: National Utility Services.

Table 3

LEVELIZED DISCOUNTED GENERATION COSTS 1990 PLANTS
(Jan. 1, 1981 cents per kWh)
(discount rate 5 percent)

Country	Capital	O & M	Fuel	Total
France (Nuclear)	1.02	0.36	0.69	2.07
USA (Coal)	1.03	0.37	1.52	2.92
USSR (Hydro)	?	?	0.00	1.00

Source: OECD, September 9, 1983.

Table 4 gives the approximate status of the competition in centrifuge technology, given in 1980 dollars. In addition to the difficulties mentioned above of comparing costs in different countries, note that none of these plants has actually been completed and operated. Prudence suggests a further reserve about what the numbers will be when the plants are on-line. However, Urenco has already built and operated some plants, and half the Portsmouth plant is already in existence, so the rankings have some credibility. Let me remind you again that these rankings are in 1980 dollars. Since then, the mark has dropped from 50 cents to 30 cents. At present exchange rates, the German and American technologies would appear to be neck-in-neck.

I have not prepared a table on the economics of the AVLIS process, since I have no confidence in my ability to project the capital and operating costs of the process when (and if) it is realized. Since many other nations are,

Table 4

THE CENTRIFUGE COMPETITION
(1980 dollars)

Technology	Capital $ per SWU per year	Power $ per SWU	O & M $ per SWU
US Set III	660	2	22
Urenco 1985[1]	500	2	11
US Set V	330	2	11

[1] Gronau, FRG.

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as they should be, interested in laser isotope separation, I do not doubt that we shall face strong competition in this technology as well.

Conclusions

It is time for us to discard the notion, which is a holdover from the years of American monopoly of uranium enrichment supply, that we have guaranteed technical superiority in all branches of isotope separation; and that this technical and economic superiority is so great that we can impose terms and conditions on our enrichment supply without regard to the preferences of our customers, or the alternatives available to them. We do have, indeed, the largest surplus enrichment capacity in the world, burdened with the highest energy costs. It is not plain why this is an advantage.

The last addition to the US gaseous diffusion plants increased the capacity over the years 1974 to 1982 by 10.1 million SWU per year, at a cost of 1.5 billion nominal dollars. Over roughly the same period, Eurodif built a green field plant of 10.8 million SWU per year, at a cost of 16 billion francs. No matter how one translates from francs to dollars, this is a respectable achievement. The French have developed a chemical exchange process for uranium enrichment, which we were unable to do. The inventor of the basic design of the modern gas centrifuge is still consulting for Urenco. This is not a time for complacency, still less for cutting back on research and development, as I was horrified to see embodied in the justification furnished for our new contract price of $135/SWU.

We also need, not *business-like* management, but *business management,* free to choose and fight for realistic goals, and free to make the hard decisions which will be required to implement them. In the long run, privatization will probably be required to achieve our objectives. Establishment of a government corporation is the essential first step.

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RECENT DEVELOPMENTS

GREECE

The Greek Institute of Geological and Mining Research (IGME) has announced the existence of a uranium production pilot plant in Paranesti, in northern Greece. The plant's construction was funded jointly by the Greek government and the European Economic Commission (EEC), and has been in operation since November 1984. IGME conducts exploration in the area and operates the pilot plant.

IGME began extensive survey operations at Paranesti in 1980, although the existence of uranium deposits in the area was documented in the early 1960s. IGME has estimated reserves at several million tonnes, and plans to issue a revised reserves estimate in the coming months. While the government's official energy plan does not mention nuclear power, the Energy Minister stated that known uranium reserves are capable of providing fuel for a 600-MWe reactor for 35 years, and the issue was now under study.

JAPAN

Kansai Electric Power Co. recently completed the planning phase for two additional 1,180-MWe PWRs, Ohi Units 3 and 4, to be located at the current Ohi site. In its first approval action for new nuclear generation facilities in 22 months, the government's Electric Power Resources Development Coordination Council (EPRDCC) granted approval to plans for the two units and officially recognized them as projects (see Report 188, April 1984, for Japan's nuclear plant licensing procedure). Kansai Electric is now prepared to submit plant designs and safety analysis for construction/operating license approvals. Commercial operation dates for the two units are scheduled for 1991 and 1992, respectively.

Similar EPRDCC approval is expected shortly for Tokyo Electric Power's Kashiwazaki Units 3 and 4, each 1,100-MWe BWRs, with commercial operation scheduled for 1993 and 1994 respectively. Chubu Electric also announced it was planning its next plant, Hamaoka Unit 4, which probably will be an 1,100-MWe BWR. A commercial operation date for the plant has not been established.

* * *

Plans for location of new enrichment, reprocessing and low-level waste storage facilities at a common location are proceeding as scheduled (see Report 193, September 1984). The governor of Aomori Prefecture, the proposed location of the facilities, announced his approval of the projects, subject to final endorsement by the prefectural assembly, expected by the end of March.

The Power Reactor and Nuclear Fuel Development Company (PNC), which developed centrifuge technology for the planned enrichment facility, also will provide reprocessing technology for the planned reprocessing facility, to be operated by Japan Nuclear Fuel Services (JNFS). PNC, under a national development program, has built and operated since 1980 an 0.7-ton-per-day demonstration reprocessing plant at Tokai Mura. The plant sustained a series of dissolver failures in 1982 and 1983, and has operated only intermittently. Dissolver repair and replacement programs recently were completed. The plant now is scheduled to return to normal operations in April. An initial goal to process 70 tons of spent LWR fuel from domestic reactors has been established. Several other developments in plans for recycling plutonium and depleted uranium have occurred in recent months:

1. Japan Atomic Power Company (JAPC) has received license approval to load two mixed-oxide fuel bundles into Tsuruga Unit 1, a 357-MWe BWR, for test purposes. In a separate study, government agencies have suggested that the utilities should plan to load mixed-oxide fuel into ten LWR units by 2000.
2. PNC successfully performed test enrichment of depleted uranium produced by its Tokai Mura reprocessing facility. PNC is proposing that the utilities support construction of a facility to re-enrich 20 to 100 tons of depleted uranium annually to demonstrate the technology.
3. PNC recently announced new cost estimates for its often-delayed, 280-MWe demonstration FBR now scheduled for operation in the mid-1990s. The current estimate exceeds $2.3 billion, a 50-percent increase from the 1979 estimate.

* * *

Japanese utilities have concluded annual price negotiations for deliveries under long-term uranium supply contracts with African and European suppliers. The utilities agreed to pay approximately $32 per pound U_3O_8 for 1986 deliveries (fiscal year ending March 31, 1986), a reduction of $1.00 to $1.50 relative to the price paid for 1985 deliveries.

The annual price negotiations are influenced greatly by developments in the spot and near-term prices over the previous year, as opposed to the months immediately preceding the negotiations. Thus, the spot/near-term prices paid in May or June 1984, when the Exchange Value was $17.75, probably had as much influence in determining FY86 long-term prices as did spot/near-term prices paid

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in February or March 1984, when the Exchange Value was $15.00.

The downward pricing trend for long-term price agreements has slowed considerably in the last few years, falling only $3.50 since FY83. Table 5 shows a comparison for the past six years of annually negotiated prices versus average Exchange Values, which have declined at a much greater rate.

Table 5

RESULTS OF ANNUAL JAPANESE URANIUM PRICE NEGOTIATIONS COMPARED TO EXCHANGE VALUE

Fiscal Year Ending March 31	Approximate Agreed Price ($/lb. U_3O_8)	Average E.V. for Preceding Japan FY (1980-85) ($/lb. U_3O_8)	Delivery Price/ Average E.V.
1981	45.00	41.17	1.1
1982	37.75	28.63	1.3
1983	35.50	23.65	1.5
1984	33.70	19.65	1.7
1985	33.50	22.10	1.5
1986	32.00	16.44	1.9

UNITED STATES

Several NRC reactor licensing actions took place in the last few months. Middle South Utilities, Inc. received a full-power license for its Waterford plant, a 1,104-MWe PWR. Commonwealth Edison received a low-power license for its Byron Unit 1, the first of two 1,120-MWe PWRs at the site. Kansas Gas and Electric Co. received a fuel-loading and low-power-testing license for its Wolf Creek plant, a 1,150-MWe PWR. Detroit Edison also received a fuel-loading and low-power-testing license for its Fermi Unit 2. Commercial operation for all four units is expected in 1985. In addition, Diablo Canyon Unit 1 reached 100-percent power in March, and is delivering 1,100 MW to the Pacific Gas & Electric grid. An inquiry by the California Public Utilities Commission has begun to determine how much of the $4 billion plant should be allowed into the rate base.

On the negative side, the low-power license granted to Long Island Lighting Company's (LILCO) Shoreham plant (see Report 199) was revoked by the Atomic Safety and Licensing Board. The 820-MWe BWR had received NRC permission to begin low-power operation only one week before. The Board revocation was based on the NRC requirement that the plant have a safe source of backup power. An NRC licensing board had bypassed that requirement by recommending that LILCO be granted an exemption. The plant's backup diesel generators are inoperable, but LILCO had submitted a plan involving smaller generators.

LILCO's emergency plan also was rejected by a New York state court, demonstrating Suffolk County's unwillingness to grant the utility authority normally wielded by state and county police in case of emergency. It now is clear that the utility will be unable to implement any emergency plan without the cooperation of local authorities, posing yet another obstacle to Shoreham's operation.

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AMPLIFICATIONS

CORRECTION

Three errors appeared in Part 2 of the Optimum Tails Assay article in Report 196 (December 1984).

1. The incremental values of the horizontal axis on Figure 1, page 14, were printed incorrectly, resulting in a misleading curve. The correct figure is reprinted below.

2. In the Appendix to the article, beginning on page 18, the implicit equations contained two errors. In the B′ equation, the (Cost Ratio) should be divided by Y, where Y equals (0.86 + 0.7 × Tails w/o) if the VTAO charge applies. (Y equals 1 if no VTAO charge applies.)

In the S equation, one component of the denominator should be (0.86 + 0.7 × Tails w/o), instead of (0.86 - 0.7 × Tails w/o).

For clarification purposes, the entire Appendix is reprinted below, with the correct equations.

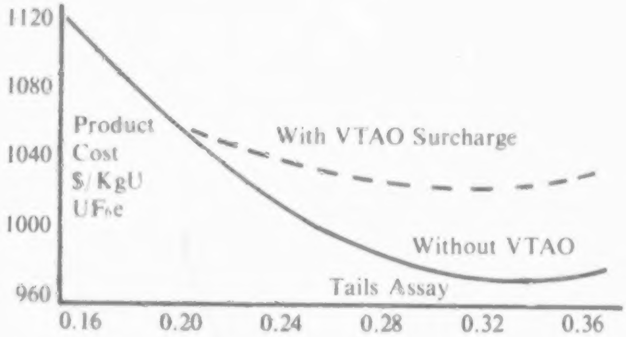

Figure 1. Cost of 3.50 w/o Product as a Function of Tails Assay for Feed at $50/KgU and Enrichment at $135/SWU.

Appendix

Tails Assay for Minimum Product Cost with Maximum VTAO Surcharge

The following series of implicit equations can be solved by iteration on a computer or programmable calculator. In this series of equations, the feed is assumed to be 0.711 w/o, and the assays are in units of weight percent, in contrast to the other equations in this article which use assay as weight fractions (weight percent = weight fraction × 100).

$$A = (\text{Tails w/o} / 50 - 1) \times (0.711 - \text{Tails w/o})$$

$$B' = 4.868883 - (\text{Cost Ratio}) / (0.7 \times \text{Tails w/o} + 0.86) + 0.985780 \times \text{Ln}\,[\text{Tails w/o} / (100 - \text{Tails w/o})]$$

$$S = 0.7 \times \text{SWU Factor} \times (0.711 - \text{Tails w/o})^2 / [(\text{Enrichment w/o} - 0.711) \times (0.86 + 0.7 \times \text{Tails w/o})]$$

$$\text{Tails w/o} = A \times 100 / [(100 - \text{Tails w/o}) \times (B' - S)]$$

The above relationships assume a VTAO credit for tails assays less than 0.2 w/o. As a result, they are incorrect for tails less than 0.2 w/o, and must be adjusted to the lesser of 0.2 w/o or the tails assay for minimum product cost without the credit (Report 195).

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URANIUM DEPOSITS IN THE USSR

Introduction

The USSR began developing nuclear power in the late 1940s. Recognized as a favorable alternative for electricity generation, nuclear power plants appeared well-suited for the highly populated regions of western USSR, which are far removed from natural energy resources in Siberia. Construction of the first nuclear generating plant (a 100-MWe liquid graphite reactor) began in early 1950; it was completed and operating in 1954, becoming the world's first nuclear power plant. Nuclear industry development continues in the USSR, although bureaucratic, engineering and construction problems during the mid-1960s, late 1970s and early 1980s have disrupted and delayed the program. The original construction schedule called for a generating capacity of over 50,000 MWe by 1985; actual installed capacity, however, totaled approximately 23,000 MWe at the end of 1984.

A recent announcement by the State Committee for Atomic Energy (GKAE) indicated that nuclear plant construction would be accelerated to increase generating capacity by 40,000 to 60,000 MWe in the mid-1990s, in order to accommodate an annual power growth rate of four percent. If this goal is achieved, approximately 60 percent of the USSR's electricity will be produced by nuclear energy. The program to increase nuclear generating capacity will require the expansion of all phases of the future U_3O_8 requirements, and exploration for new ore deposits along with the development of known deposits has accelerated.

Limited information concerning uranium deposits in the USSR is available from Soviet sources; that information is often limited to deposits which have been developed for industrial purposes. Soviet documentation offers geologic descriptions of certain deposits in considerable detail, while others, thought to be major deposits, are not specified. Ore reserves and percent of uranium content are never cited. Geologic setting and ore genesis are often described, indicating the wide variety of uranium occurrences. The geographic locations of most deposits usually are not described. Association by geologic setting is the principal method Western geologists use to establish location. Still, the location of certain deposits may be only approximate at best. There is even less documentation regarding ore body development and recovery technology.

The *Raw Materials* section of Report 194 (October 1984) examines uranium ores in the Zholtye Vody district of the Ukraine.

Classification of Uranium Deposits

Uranium occurrences in the USSR correspond to many known occurrences in the western world. Significant exceptions are the absence of large-tonnage Precambrian quartz-pebble conglomerates similar to the Witwatersrand Basin of South Africa and the Elliot Lake district of Ontario, Canada, and Proterozoic unconformity-related deposits in the Northern Territory of Australia and the Athabasca Basin of northern Saskatchewan, Canada. However, Soviet geologists remain optimistic that important deposits in both types of geologic environment will be discovered eventually.

Uranium occurrences in the USSR generally are classified by vein-type and hydrothermal mineralization. Vein deposits are associated mainly with intrusive and metamorphic rocks; hydrothermal deposits are associated directly with sedimentary rocks, from sandstones to shales, and coal beds. Uranium deposits are subdivided into four basic series. Each series is further divided into classes and specific types of deposit.[1]

1. The *series* of the deposit is determined by geologic position and age, as well as genetic relationship;
2. The *class* of deposit is established by mineralogy, structural form and association with surrounding host rocks;
3. The *type* of deposit depends on the local geologic features controlling mineralization. A total of 16 types of ore deposits have been described. Table 6 lists and briefly describes each type.

Conclusion

Figure 2 illustrates the location of many important uranium districts and production centers in the USSR. Uranium is produced (or has been produced) from all 16 types of deposits listed in Table 6, although the actual importance of each to the uranium supply program is unknown. Certain types of deposits have not contributed to U_3O_8 requirements, while others have served as a main supply. The principal differences between deposits are total tonnage available, contained U_3O_8, accessibility to mining, and favorable metallurgy.

---

[1] Kazanskiy, V. I., and Laverov, N. P., *Mestorozhdienia Urana (Uranium Ore Deposits)*—Nedra, Moscow, 1974.

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Table 6

URANIUM ORE CATEGORIZATION IN THE USSR

SERIES A. *Metamorphogenic deposits of ancient platforms.* Uranium mineralization in Precambrian basement intrusives and metamorphic rocks. Tectonic and metasomatic zones contain important vein deposits.

> Type 1. *Iron-uranium mineralization associated with sodium and carbonate-rich metasomatites.* Intrusions and folding influenced placement of ore in lower conglomerates, middle hematite-magnetite zones, and upper graphite schists and dolomitic marbles.
>
> Type 2. *Uranium associated with sodium-rich metasomatic rocks.* Ore minerals occur in elongated folds at basement contacts. Host rocks are the iron formation, migmatites and mylonites.

SERIES B. *Endogenic deposits of fold regions.* Ore associated with volcano-intrusive rocks in deep-seated geosynclinal fold belts.

> Class I. *Hydrothermal minerals in andesites-diorites.* Uranium-molybdenum minerals in both rock types, associated with post-orogenic hydrothermal activity.
>
> > Type 3. *Uranium associated with dikes.* Diorite dikes associated with syenite intrusives cut lower sedimentary rocks. Ore is in conglomerates, sandstones and argillites.
> >
> > Type 4. *Uranium-molybdenum ore in paleovolcanoes and related minor intrusions.* Deposits are in fold-belts of Paleozoic rocks, along faults and folds at intrusive contacts in association with altered sandstone and pyroclasic rocks.
> >
> > Type 5. *Apatite-uranium deposits in paleovolcanoes and carbonate-marine sediments.* Ore occurs in carbonate rocks interbedded with shales and sandstones; ore controlled by faulting and volcanogenic rock sequence.
>
> Class II. *Hydrothermal deposits associated with rhyolite-granitic rocks.* Ore is concentrated in volcanogenic depressions and related fault zones; ore formed during post-volcanic hydrothermal activity.
>
> > Type 6. *Uranium deposits in volcanic depressions.* Ore is of late Paleozoic age, occurring in rhyolite tuffs and breccias associated with caldera tectonics.
> >
> > Type 7. *Molybdenum-uranium deposits in subvolcanic intrusives.* Ore occurs along contact zones of highly fractured and faulted Paleozoic granite and quartz porphyries and intruded andesite.
> >
> > Type 8. *Molybdenum-uranium deposits in volcanic pipes and plugs.* Ore occurs in stockworks and veins in breccia and mylonite zones resulting from volcanic intrusion and accompanying subsidence of Paleozoic basement rocks.

SERIES C. *Endogenic uranium deposits of reactivated regions.* Hydrothermal uranium deposits occur in trachyte-syenite and andesite-rhyolite rocks along reactivated tectonic zones.

> Class III. *Hydrothermal deposits associated with trachyte-syenite rock formations.* Important hydrothermal uranium deposits occur in sodium-rich intrusives, with thorium in subvolcanic massifs, and titanium in crystalline basement rocks.
>
> > Type 9. *Thorium-uranium deposits in subvolcanic massifs.* Ore is associated with sodium-rich deep-seated intrusives cutting basement rocks; ore occurs in fracture and breccia zones along major faults.

(continued)

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Table 6 *(continued)*

URANIUM ORE CATEGORIZATION IN THE USSR

Type 10. *Titanium-uranium deposits in faulted crystalline basement rocks.* Uranium of hydrothermal origin occurs in tectonic breccias and veins throughout altered and uplifted blocks of crystalline rocks.

Class IV. *Hydrothermal deposits associated with andesite-rhyolite rocks.* Uranium mineralization occurs in stockworks and veins in andesite-rhyolite rocks filling deep depressions in the basement complex. Molybdenum is a common co-mineral.

Type 11. *Fluorite-uranium deposits in erosional tectonic basins.* Uranium ore occurs in Paleozoic metamorphic and igneous rocks associated with caldera depressions filled with volcanic flows; the ore forms in veins, stockworks in the older rocks, and as bedded deposits in younger volcanics.

Type 12. *Arsenic-uranium deposits in erosional tectonic depressions.* Ore minerals are confined to hydrothermally altered sediments filling depressions in granites; basal conglomerates, sandstones and interbedded tuffs are host to ore deposits.

SERIES D. *Exogenic deposits of younger platforms.* Sedimentary-origin uranium deposits occur in lower Tertiary rocks covering Paleozoic platforms. Most deposits are strataform in nature and considered to be epigenetic.

Class V. *Epigenetic infiltration deposits.* Ore deposits are associated with carbonate rocks in sedimentary formations, controlled by interaction of descending (and ascending) oxidized and mineral-bearing solutions.

Type 13. *Vanadium-uranium deposits in carbonates.* Ore is found in Tertiary formations overlying Paleozoic platform rocks. Vanadium is associated where organic material is abundant; carbonates create favorable host in sand-clay beds.

Type 14. *Selenium-uranium deposits in terrigenous sediments.* Ore has developed in zones of oxidation along formation contacts, usually in folded and faulted sediments covering young platforms. Ore is found throughout the sedimentary sequence, with important ore in sandstones and conglomerates.

Type 15. *Uranium in coal-bearing sediments.* The coal-bearing depositional sequence is 80 to 200 meters thick, composed of five sequential units deposited on lower Mesozoic rocks. Uranium is absorbed into the coal beds, and occurs in mudstone and sandstone units directly below the coal.

Class VI. *Sedimentary-diagenetic deposits.* Mineralization is associated with specific sedimentary horizons during the diagenetic process of deposition and lithification.

Type 16. *Rare earth*–uranium deposits in clay. Uranium mineralization is associated with clay horizons formed by shallow marine deposition; horizons contain rare earth, fish fragments and coalified remnants of plants. Uranium is abundant in fish remains, less so in plant debris.

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It is difficult to determine which of the 16 types of deposits are the most important to U_3O_8 supply. It is likely that a number of sources play an important role. Also, many types of deposits found in the USSR, when compared with deposits elsewhere, are low-grade and have questionable recovery economics and difficult metallurgy. Production from molybdenum-uranium deposits in volcanogenic rocks and iron-uranium deposits in the iron-bearing sequence has been consistent in the past and may represent the most important sources of uranium.

Not listed in Table 6 are the uranium-bearing phosphorites, oil shales, alkaline granites and carbonatites, all of which contain large quantities of low-grade uranium. Each represents a future source of uranium that can be recovered using other technologies and depending on U_3O_8 requirements. For example, the phosphate deposits in the Zeysk area are now under development, but a plan to recover the uranium contained in the ore has not been announced. The low-grade uranium resources may become an important source of U_3O_8 in the future unless new conventional high-grade deposits are discovered during the early stages of GKAE's current exploration program.

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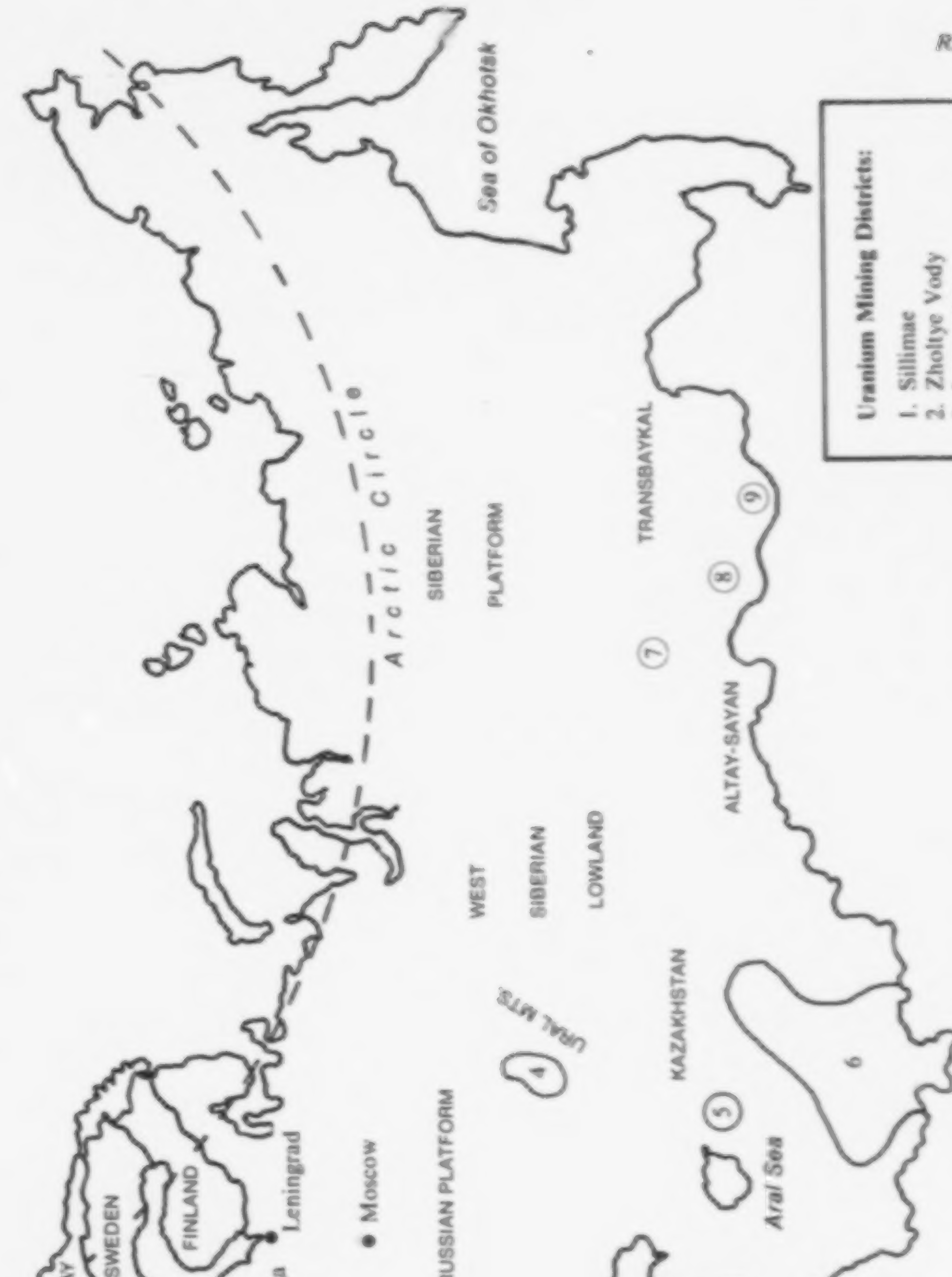
Sea of Okhotsk
Arctic Circle
SIBERIAN
PLATFORM
TRANSBAYKAL
WEST
SIBERIAN
LOWLAND
ALTAY-SAYAN
URAL MTS.
KAZAKHSTAN
NORWAY
SWEDEN
FINLAND
Leningrad
Moscow
RUSSIAN PLATFORM
Riga
Baltic Sea
Aral Sea
Caspian Sea
CAUCASUS MTS.
Odessa
Black
Sea
1
2
3
4
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9

Uranium Mining Districts:

1. Sillimae
2. Zholtye Vody
3. Lermontov
4. Central Ural Mountains
5. Uchkuduk
6. Chatkal
7. Vikhorevka
8. Lake Baykal
9. Krasnokamensk

Figure 2. Location map of uranium mining districts in western and central USSR. Each district represents one or more production centers. (Adapted from R.S. Mathiason, 1980.)

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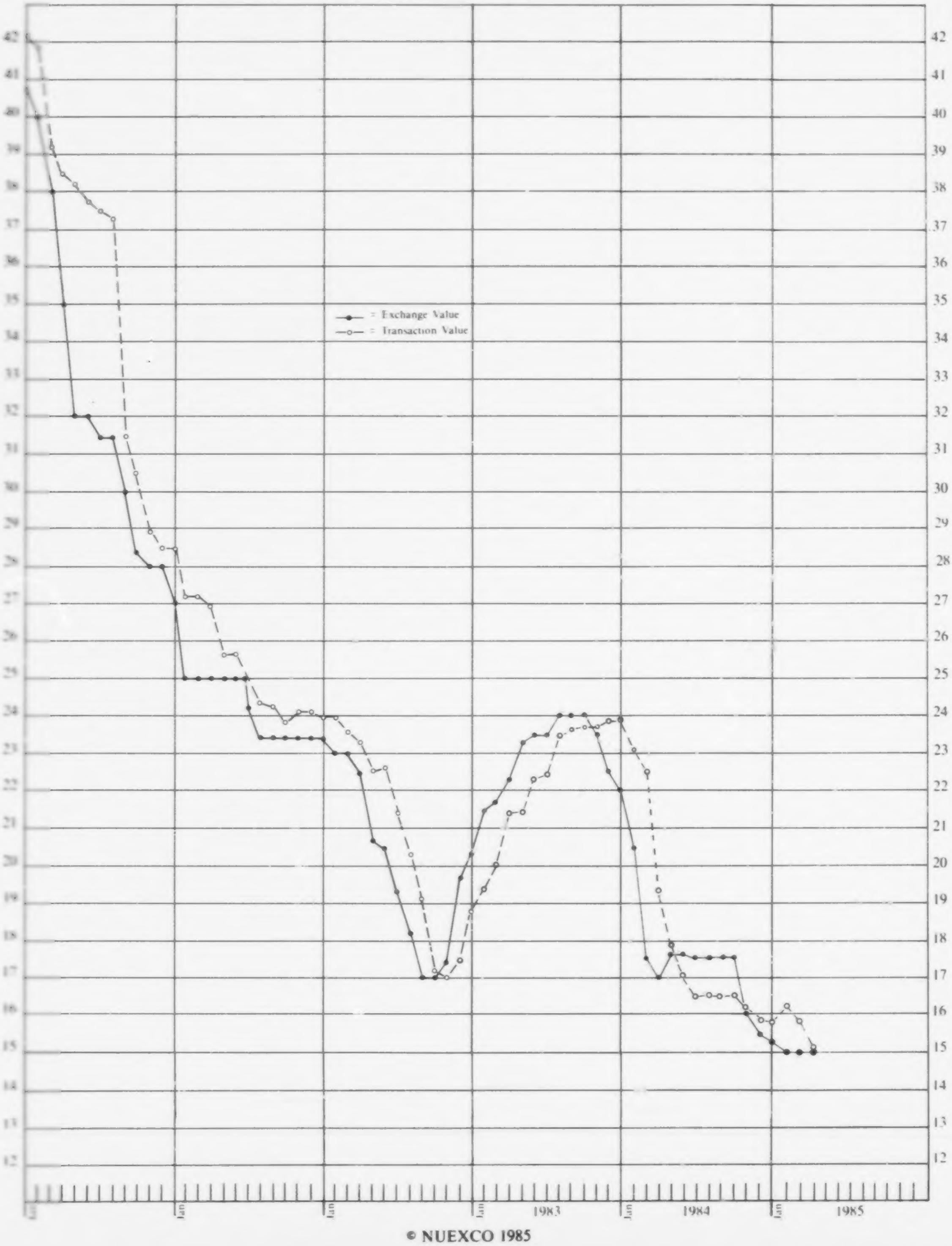
HISTORICAL MARKET DATA

EXCHANGE AND TRANSACTION VALUES SINCE JANUARY 1980

Determined as of the last day of the month indicated



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HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	—	—	—	—	—	—	—	6.35	6.35	6.40	6.45	6.50
1969	—	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	32.50	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00
1981	25.00	25.00	25.00	25.00	25.00	24.25	23.50	23.50	23.50	23.50	23.50	23.50
1982	23.00	23.00	22.50	20.75	20.50	19.25	18.25	17.00	17.00	17.50	19.75	20.25
1983	21.50	21.75	22.25	23.25	23.50	23.50	24.00	24.00	24.00	23.50	22.50	22.00
1984	20.50	17.50	17.00	17.75	17.75	17.50	17.50	17.50	17.50	16.00	15.50	15.25
1985	15.00	15.00	**15.00**									

HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	—	—	—	—	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38.40	37.90	37.60	37.30	31.60	30.60	29.00	28.70	27.70
1981	27.20	27.20	27.00	25.70	25.70	24.50	24.40	24.30	23.90	24.10	24.10	24.00
1982	24.00	23.70	23.40	22.60	22.70	21.50	20.30	19.10	17.30	17.00	17.55	18.80
1983	19.35	20.00	21.35	21.40	22.35	22.45	23.50	23.60	23.65	23.65	23.85	23.85
1984	23.05	22.50	19.25	17.90	17.00	16.50	16.60	16.40	16.55	16.05	15.90	15.90
1985	16.20	15.70	**15.05**									

HISTORICAL CONVERSION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U as UF_6)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	1.20	1.20	1.20	1.40	1.15	1.15	1.15	1.10	1.10	1.10	1.20	1.20
1982	1.20	1.20	1.20	1.20	1.00	1.00	1.00	0.90	1.10	1.60	1.45	1.45
1983	1.20	1.40	1.40	1.20	1.20	1.20	1.10	1.10	1.00	0.60	0.60	0.60
1984	0.60	0.30	0.80	0.80	0.80	0.00	0.00	0.80	1.00	1.00	0.80	0.80
1985	1.00	1.00	**1.00**									

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GOVERNMENT STATISTICS

AUSTRALIA

	Price Index of Materials Used in Manufacturing Industry—All Groups[1] (1969=100)	Award Rates of Pay Indexes Australia—Adult Males In Mining Wage and Salary Earners, Weekly Rates[2] (1976=100)
1983 Avg.	401.2	181.8
Nov 1983	395.5	188.3
Dec 1983	399.2	188.1
Jan 1984	399.2	188.6
Feb 1984	402.5	188.5
Mar 1984	403.9	188.3
Apr 1984	404.2	196.2
May 1984	403.8	197.0
Jun 1984	404.9	197.0
Jul 1984	408.5	197.0
Aug 1984	413.3	197.0
Sep 1984	412.1	197.0
Oct 1984	408.6	197.0
Nov 1984	407.2	197.0
Dec 1984	—	197.0

P = Preliminary R = Revised since last month

CANADA

		Wage-earner Data: Average Hourly Earnings (C$)[2]					
	Industry Selling Price Index: Manufacturing[1] (1971=100)	Uranium Mines (SIC 057)	Metal Mines* (SIC 051-059)	Mines, Quarries and Oil Wells[3] (SIC 051-099)	Primary Metal Industries Non-ferrous[4] (SIC 296)	Primary Metal Industries Non-ferrous[4] (SIC 298)	Chemicals and Chemical Products[5] (SIC 372-379)
1983 Avg.	298.8	—	—**	14.30	—	—	11.17
Jan 1984	305.4	17.74	15.27	14.74	11.91	10.84	11.69
Feb 1984	306.6	17.78	15.59	14.90	12.04	10.82	11.51
Mar 1984	308.7	18.05	15.52	14.82	12.14	10.84	11.58
Apr 1984	310.5	18.06	15.83	15.10	11.96	10.34	11.63
May 1984	310.6	18.48	15.64	15.06	12.11	10.16	11.65
Jun 1984	311.0	18.08	15.48	14.80	12.38	10.40	11.66
Jul 1984	312.7	17.81	15.72	14.92	12.53	10.18	11.82
Aug 1984	312.7	17.24	15.36	14.92	12.44	10.34	11.78
Sep 1984	312.3	17.68	15.96	15.34	12.51	10.52	11.90
Oct 1984	312.3	17.64	16.15	15.26	12.69	10.56	11.96
Nov 1984	313.6	18.04	16.13	15.43	12.47	10.51	11.96
Dec 1984	314.2R	17.95R	16.39R	15.60R	12.16R	10.40R	11.99R
Jan 1985	315.6R	18.20P	16.03P	15.52P	12.32P	10.89	12.07P
Feb 1985	316.0P	—	—	—	—	—	—

P = Preliminary R = Revised since last month

For annual averages prior to 1983, and for notes pertaining to these statistics, see pages 23-26 of Report 190 of June 1984.

*The 1980 average for Metal Mines was incorrectly reported as 10.59. The correct average is 10.58 (see Report 190).

**Two different methods were used in the 1983 "Metal Mines" category in reporting survey data, and Statistics Canada did not publish a 1983 average. The March 1983 figure for the old method was 14.73 and for the new method was 14.84. The published average for 1983 in Report 190 was a Nuexco calculation based on the available monthly statistics for 1983 with the exception of the March figure, where only the 14.84 value was taken into account.

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REPUBLIC OF SOUTH AFRICA

	Average Declared Working Costs per per Metric Ton of Gold Ore Milled (Rand)[1]	Tonnage-Weighted Index of Average Working Costs per Metric Ton of Gold Ore Milled (March 1982=100)[2]	Consumer Price Index[3] (1975=100)[4]	Producer Price Index All Groups[5] (1975=100)	Total Employment in Mining and Quarrying (Code 35)[6]	Total Salaries and Wages in Mining and Quarrying (1,000 Rand) (Code 40)[5]
1983 Avg.	51.87	115.0	262.2	274.8	696,579	3,644,772
Jan 1984	—	—	274.7	283.3	689,807	326,619
Feb 1984	—	—	278.4	286.5	702,553	335,906
Mar 1984	55.30	123.1	281.9	288.0	715,628	342,332
Apr 1984	—	—	286.1	290.2	712,963	327,550
May 1984	—	—	288.3	292.6	710,040	327,937
Jun 1984	56.95	126.2	291.2	295.3	717,009	347,121
Jul 1984	—	—	295.1	296.0	717,121	369,964
Aug 1984	—	—	297.0	300.8	721,905	361,357
Sep 1984	60.64	133.2	299.9	304.1	721,470	359,218
Oct 1984	—	—	303.7	308.7	717,865	363,755
Nov 1984	—	—	307.4	312.8	717,396	369,771
Dec 1984	62.92	138.6	309.4	315.9	701,198	365,234
Jan 1985	—	—	177.1*	166.6*	—	—
Feb 1985	—	—	182.8*	—	—	—

*The basis for calculation for these indices has been revised to January 1980 = 100.

UNITED STATES

	Producer Price Index[1]		Consumer Price Index[2]	GNP Implicit Price Deflator[3]	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[4]			
	Industrial Commodities (1967=100)	All Commodities (1967=100)	(1967=100)	(1972=100)	Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)	Electric and Electronic Equipment (SIC 36)
1983 Avg.	315.8	303.1	298.4	215.63	12.57	13.43	10.59	8.65
Dec 1983	318.4	306.1	303.5	218.53	12.75	13.33	10.90	8.84
Jan 1984	319.1	308.0	305.2	—	12.67	13.38	10.91	8.88
Feb 1984	320.6	308.9	306.6	—	12.81	13.34	10.90	8.86
Mar 1984	321.9	311.0	307.3	220.58	12.85	13.33	10.95	8.88
Apr 1984	322.5	311.4	308.8	—	12.91	13.30	10.97	8.89
May 1984	323.3	311.7	309.7	—	12.99	13.37	11.02	8.89
Jun 1984	323.9	311.4	310.7	222.40	12.96	13.40	11.03	8.91
Jul 1984	324.0	312.0	311.7	—	13.02	13.36	11.12	8.95
Aug 1984	323.5	310.9	313.0	—	13.10	13.51	11.13	9.00
Sep 1984	322.3	309.5	314.5	224.57	13.20	13.39	11.23	9.08
Oct 1984	323.2	309.4	315.3	—	13.23	13.53	11.32	9.09
Nov 1984	323.8	310.4	315.3	—	13.23	13.76	11.35	9.15
Dec 1984	323.0	309.9	315.5	226.10	13.28R	13.66R	11.37R	9.27R
Jan 1985	323.2	309.8	316.1	—	13.26P	13.73	11.43R	9.29R
Feb 1985	322.5	309.2	317.4	—	—	—	11.40P	9.30P

P = Preliminary R = Revised since last month

For annual averages prior to 1983, and for notes pertaining to these statistics, see pages 23–26 of Report 190 of June 1984.

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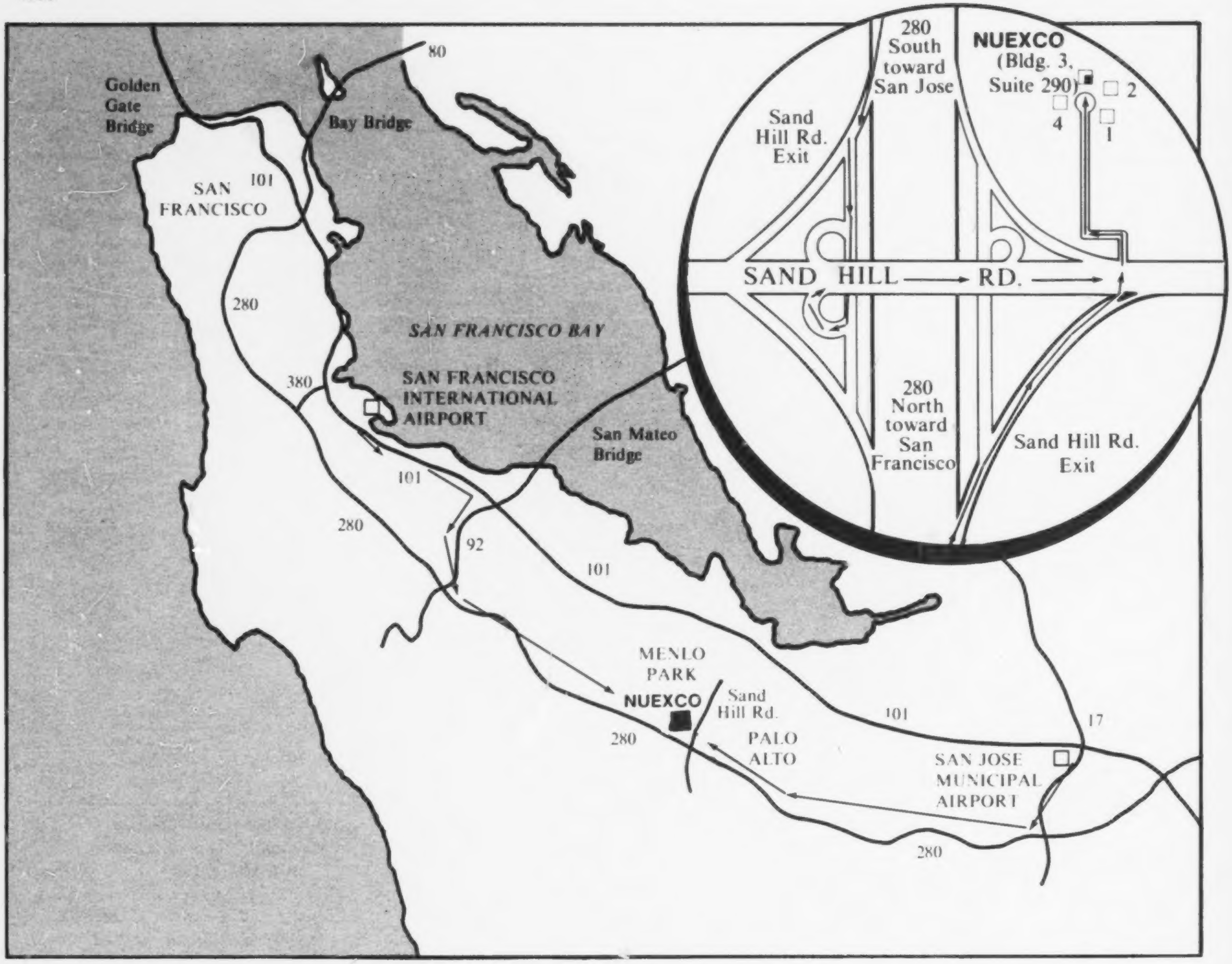
Golden Gate Bridge
80
Bay Bridge
SAN FRANCISCO
101
280
SAN FRANCISCO BAY
380
SAN FRANCISCO INTERNATIONAL AIRPORT
San Mateo Bridge
101
92
280
101
MENLO PARK
NUEXCO
Sand Hill Rd.
280
PALO ALTO
101
17
SAN JOSE MUNICIPAL AIRPORT
280
280 South toward San Jose
NUEXCO (Bldg. 3, Suite 290)
2
4
1
Sand Hill Rd. Exit
SAND HILL RD.
280 North toward San Francisco
Sand Hill Rd. Exit

DIRECTIONS TO NUEXCO'S CORPORATE OFFICES

From San Francisco Airport:

1. Take U.S. 101 south towards San Jose.
2. Continue on U.S. 101 seven miles to Route 92 exit.
3. Take Route 92 west towards Half Moon Bay.
4. Continue on Route 92 five miles to Interstate 280 exit.
5. Take Interstate 280 south towards San Jose.
6. Continue on Interstate 280 ten miles to Sand Hill Road exit.
7. Take Sand Hill Road east towards Menlo Park (go under Sand Hill Road overpass, circle 270° to cross Interstate 280 on overpass heading east).
8. Turn left at first traffic light.
9. After turning left, take second left and follow signs for 3000 Sand Hill Road.
10. We are in Building 3, Suite 290, on the second floor.

From San Jose Airport:

1. Take Highway 17 south towards Santa Cruz.
2. Continue on Highway 17 five miles to Interstate 280 exit.
3. Take Interstate 280 north towards San Francisco.
4. Continue on Interstate 280 six miles to Sand Hill Road exit.
5. Take Sand Hill Road exit.
6. Proceed through both sets of traffic lights.
7. Take first left after second traffic light and follow signs for 3000 Sand Hill Road.
8. We are in Building 3, Suite 290, on the second floor.

Note: Distances are approximate.

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Holiday Inn-Palo Alto, 625 El Camino Real, Palo Alto, (415) 328-2800
Rickey's Hyatt House, 4219 El Camino Real, Palo Alto, (415) 493-8000
Fairmont Hotel, 950 Mason Street, San Francisco, (415) 772-5000

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Velvet Turtle, 325 Sharon Park Drive, Menlo Park, (415) 854-3813
Ming's of Palo Alto (Chinese), 1700 Embarcadero Road, Palo Alto, (415) 327-0771
Hugo's Market Restaurant (at Hyatt), 4219 El Camino Real, Palo Alto, (415) 493-8000

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NUEXCO

EXECUTIVE SUMMARY
REPORT 200
(All data as of March 31, 1985)

Exchange Value
$15.00, unchanged

The **Exchange Value** is **$15.00** per pound U_3O_8, unchanged since last month. Eleven recent natural uranium sales are reported, involving approximately 2.1 million pounds U_3O_8 equivalent. All involved delivery prior to 1986, and ten met the conditions for inclusion in the Transaction Value. Three involved natural UF_6.

Supply-Demand Ratio
fell to 1.0:1

Active spot and near-term **uranium supply** amounts to **4.3 million** pounds U_3O_8 equivalent, down 1.1 million pounds since last month. Active spot and near-term **uranium demand** totals **4.1 million** pounds, up 1.8 million pounds. The spot and near-term **supply-demand ratio** declined to **1.0:1.**

Transaction Value
fell to $15.05

The **Transaction Value** is **$15.05** per pound U_3O_8, down $0.65 since last month. The calculation includes 16 transactions involving a total of 2.4 million pounds U_3O_8 and equivalent UF_6, and covers a period of 3 months.

Loan Use Charge Rate
unchanged at 5%

The **Loan Use Charge Rate** is **5 percent** per annum, unchanged.

Conversion Value
unchanged at $1.00

The **Conversion Value** is **$1.00** per pound U as UF_6, unchanged since last month. One secondary market conversion transaction is reported, involving approximately 200,000 pounds U as UF_6. Active secondary market supply for conversion services for delivery within three years totals 110 thousand pounds U as UF_6. Active demand totals 255 thousand pounds U as UF_6. The secondary conversion market is developing a severe dichotomy: sellers of natural UF_6 need to offer discounts of 25 to 35 percent on the contained conversion in order to stimulate buyer interest. On the other hand, buyers of secondary market conversion services need to pay as much as a 50-percent premium to attract a willing seller.

SWU Values:
$98 for DOE-origin (FY85)
$25 discount for FY86
$80 for non-DOE origin
calendar year 1985
$85 for calendar year 1986

The **SWU Values** for DOE origin at .3 tails and certifiable as excess, are **$98** per SWU for FY85 delivery, and **$25** per SWU discount from DOE base price for FY86 delivery. SWU Values for other SWUs (non-DOE or non-certifiable) are **$80** per SWU for calendar year 1985 delivery, and **$85** per SWU for calendar year 1986 delivery. One secondary market SWU transaction is reported, involving 300 to 600 thousand SWUs of Eurodif origin.

Analysis & Commentary

Dr. Karl Cohen, a pioneer in the theory of gas centrifuge enrichment technology, in a presentation at the A.I.F. Conference, concluded that the establishment of a government corporation to oversee the enrichment enterprise was necessary in the USA.

Greece

The existence of a uranium production pilot plant in operation since late 1984 was announced, and further exploration and development plans now are under way.

Japan

Annual uranium price negotiations with suppliers took place in recent months.

United States

Several nuclear plants received operating licenses in February and March, but the Atomic Safety and Licensing Board revoked LILCO's low-power license for its Shoreham plant.

Raw Materials

Uranium is produced from a wide variety of deposits in the USSR, which are categorized by class and type of occurrence.

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NUEXCO REPORT 200 FIGURES OF THE MONTH (March 31, 1985)	This Month (Report 200)	Last Month (Report 199)	12 Months Ago (Report 188)
Exchange Value[1]	15.00	15.00	17.00
Transaction Value[1]	15.05	15.70	19.25
Loan Use Charge Rate[2]	5%	5%	6%
Conversion Value[3]	1.00	1.00	0.80
Near-Term Uranium Supply[4]	4.3	5.3	6.1
Near-Term Uranium Demand[5]	4.1	2.3	3.8
Near-Term Supply-Demand Ratio	1.0	2.3	1.6
Recent Uranium Sales:			
Number of Transactions[6]	11	9	9
Quantity of Material[7]	2.1	2.1	1.5-3.0
Nuexco SWU Values:[8]			
DOE origin, certifiable as excess, 0.3 tails assay			
FY85 delivery	98	102	100
FY86 delivery	25[9]	20[9]	—
Other SWUs (non-DOE or non-certifiable)			
1985 delivery	80	80	80
1986 delivery	85	88	—
USDOE SWU Prices:			
USEC	135.00	135.00	135.00
AFC	153.00[10]	153.00[10]	153.00
Requirements	157.00[10]	157.00[10]	157.00
Market Value of Enriched UF_6[11] [12]:			
2.5 w/o U_{235}	471	481	531
3.0 w/o U_{235}	608	621	684
3.5 w/o U_{235}	748	765	840
4.0 w/o U_{235}	890	911	998

---

[1] US $ per pound U_3O_8 equivalent.

[2] Per annum.

[3] US $ per pound U as UF_6.

[4] Active inquiries to sell, for delivery within 12 months after contract signing (millions of pounds U_3O_8).

[5] Active inquiries to purchase, for delivery within 12 months after contract signing (millions of pounds U_3O_8).

[6] Uranium sales only; does not include loans, conversion, or SWU transactions.

[7] Millions of pounds U_3O_8, equivalent.

[8] US $ per SWU.

[9] Discount from USEC base price on delivery.

[10] Effective 10/1/84.

[11] Calculated using the Nuexco Exchange Value, Conversion Value, and 0.30 percent tails assay. From 10/31/83 through 2/29/84, calculations used the Nuexco SWU Value for DOE origin and FY84 delivery. As of 3/31/84, calculations use the Nuexco SWU Value for DOE origin and FY85 delivery.

[12] US $ per KgU as UF_6, rounded to the nearest $.

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MAY 1985 **NUMBER 201**

MONTHLY REPORT

ON THE NUCLEAR FUEL MARKET

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NUEXCO

MONTHLY REPORT ON THE NUCLEAR FUEL MARKET
May 1985 No. 201

R. WESLEY MILLER, *EDITOR* CLARK M. BEYER, *ASSOCIATE EDITOR*

PRICING

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Enriched Uranium and SWUs 2

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NUEXCO

To Our Readers

Nuexco's US offices will be closed for the Memorial Day holiday on Monday, May 27, 1985.

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NUEXCO

PRICING

NATURAL URANIUM AND SECONDARY MARKET CONVERSION

The **Exchange Value** as of April 30, 1985 is **$14.25** per pound U_3O_8, down $0.75 since last month. **Active supply** of natural uranium (U_3O_8 and UF_6) for spot or near-term delivery totals **2,720,000** pounds equivalent U_3O_8 as concentrates or UF_6, down 1,530,000 pounds since last month. The corresponding figure for **active demand** is **1,395,000** pounds, down 2,660,000 pounds. The spot and near-term **supply-demand ratio** rose to **2.0:1.**

The *Current Market Data* section of this Report lists five natural uranium sales transactions, involving a total of approximately 1,700,000 pounds U_3O_8 equivalent. All of the transactions reported this month involved deliveries before 1986, and four met the criteria for inclusion in the current Transaction Value calculation.

The **UF_6 Value** as of April 30, 1985, is **$40.50** per kilogram U in UF_6. Two of the transactions reported this month involved UF_6. This is the first time Nuexco has published a value for natural uranium hexafluoride. Over half of the natural uranium sold in 1984 for spot or near-term delivery (as reported by Nuexco) involved UF_6, and that percentage was even higher for longer-term deliveries. Furthermore, the conversion component of UF_6 when the UF_6 is being offered to buyers who prefer U_3O_8 is worth substantially less than is being paid by buyers that want secondary market conversion services *per se*. Thus, the market value of UF_6 can be somewhat less than that derived from the algebraic combination of Exchange Value plus Conversion Value.

The **Transaction Value** as of April 30, 1985 is **$14.90** per pound U_3O_8, down $0.15 since last month. The current Transaction Value includes 20 transactions involving a total of 2.9 million pounds U_3O_8 or equivalent UF_6 and covers a period of 3 months. The Transaction Value fell slightly as a result of the gradual decline of transaction prices that has taken place over the last several months.

The **Loan Use Charge Rate** as of April 30, 1985 is unchanged at **5 percent** per annum, as a lender continued to offer a substantial quantity of material at that rate.

* * *

The substantial decline in this month's Exchange Value is largely attributable to two factors that have continued the weakening of the spot/near-term market.

1. The few buyers in the market have exhibited highly discretionary tendencies, and it is unclear where the next strong demand for immediate delivery of material will emerge.

2. One US producer closed its operations and liquidated its substantial inventory in a short time at a price well below last month's Exchange Value.

An increase in market activity in February and March led to increased competition in April for lower prices for concentrates. After three months of Exchange Value stability, the market once again weakened, reflecting a renewed discretionary attitude among buyers. Much of the recent activity is occurring between producers and traders or other intermediaries, while utilities appeared to be anticipating another downward price slide.

The inventory liquidation by a US producer released a substantial quantity of U_3O_8 on the market in April. In a matter of hours the material was sold at prices well below the $15.00 level. The material had been held off the market for the past several months in connection with negotiations to sell the producer's US uranium operations. The sale of the 1.5-million-pound inventory may have signaled the end of those negotiations, but other scenarios are conceivable. Potential buyers of the company's properties may have had no near-term need for the concentrates and were unwilling to pay current market prices merely to put the material in their inventory. Also possible is the interest by the company's parent corporation in raising cash to help pay down the debt associated with the acquisition of the company.

It has not yet been possible to identify all of the buyers involved, but it is known that deliveries extend over the remainder of 1985. As noted previously by Nuexco, recovery of spot market prices cannot occur until the market is cleared of overhanging inventory such as the material sold in April. The impact on prices, while discouraging to producers, can be expected in a market dominated by discretionary buyers.

* * *

Beginning with this issue, Nuexco will publish a market value for natural uranium hexafluoride. The **UF_6 Value** is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium hexafluoride could be concluded as of the date indicated. The addition of this value is a cumulative result of many factors, including the following:

1. Over half of the natural uranium sold on the spot/near-term market in 1984 (as reported by Nuexco) involved UF_6, and nearly two-thirds of the material sold in the longer-term market in 1984 involved UF_6.

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2. Transactions involving UF_6 comprised more than half of the total quantity of natural uranium sold in early 1985 (as reported by Nuexco).

3. Current demand for UF_6 is about the same as the demand for uranium concentrates.

4. Two apparently contradictory pricing situations for conversion services have been present in the market for some time. Buyers of conversion on the secondary market may have to pay close to $1.50 for the conversion to UF_6 because the few discretionary sellers in the market can command those prices. If, however, a buyer is interested in obtaining uranium concentrates, a UF_6 seller must substantially discount the price of the conversion component in its material in order to make the sale. Therefore, the present value of UF_6 is slightly less than the sum of the price of U_3O_8 plus the price of secondary market conversion.

While uranium concentrates have been the more saleable commodity in the past, inventory sales of UF_6 and other transactions involving UF_6 on the secondary market have increased enough to warrant the publication of a commercial monthly value. In some instances in the past, equating the value of UF_6 with the sum of the Exchange Value plus the Conversion Value rendered an accurate picture of market conditions. That situation remains a possibility in the future. However, present conditions demonstrate that the value of UF_6 can be somewhat *less* than the sum of the other two values. To organize a swap, the seller must find buyers who need complementary amounts of concentrates and conversion. This usually requires a price concession on the part of the UF_6 seller for the conversion component. Location differences may present obstacles to a swap, in which case there may also be some price adjustment.

The addition of a UF_6 Value will enable a clearer and more complete analysis of spot and near-term market prices for nuclear fuel. It will give a better picture of the uranium market, and will eliminate misconceptions stemming from the assumption that the sum of the U_3O_8 component and the conversion component will equal the value of UF_6.

* * *

The **Conversion Value** is **$1.50** per pound U in UF_6, up $0.50 since last month. No secondary market conversion transactions are reported. Active supply of secondary market conversion services for delivery within three years totals 550,000 pounds U as UF_6. Active secondary market demand for conversion amounts to 290,000 pounds U in UF_6.

Recent indicators in the conversion market suggest that prices in the secondary market for conversion services are approaching primary market prices. While several buyers exist, only two active sellers remain in the secondary market, and these discretionary sellers are dictating current prices. Buyers that want conversion must pay prices near $1.50 per pound U as UF_6, even though sellers of UF_6 may have to substantially discount the conversion component of their material in order to sell to a buyer that needs uranium in any form. Thus, the conversion component of UF_6 can have substantially different values, depending on the motivations of the buyer and seller. In one case, the acquisition of conversion is the primary motivation for a transaction, and a buyer must pay a higher price. In the other case, the sale of natural UF_6 feed material to a buyer that prefers concentrates is the primary motivation, so the UF_6 seller has to discount the unwanted conversion in order to compete with sellers of concentrates.

ENRICHED URANIUM AND SWUS

The Nuexco **SWU Values** as of April 30, 1985 are:

1. For **DOE origin,** a tails assay of 0.30 weight-percent U_{235}, for delivery by the end of FY86, and certifiable as excess, $95 per SWU.

2. For **other** SWUs (includes DOE origin SWUs not certifiable as excess and non-DOE origin SWUs):

   a. For delivery in calendar year 1985, $80 per SWU, unchanged;

   b. For delivery in calendar year 1986, $85 per SWU, unchanged.

One secondary market SWU transaction is reported, involving less than 50 thousand SWUs of DOE origin.

* * *

The lack of demand for DOE certifiable SWUs for delivery in FY85, as well as the April closing of the time window for satisfying the DOE requirement for 180-day notice for FY85 delivery, effectively closed the secondary market for FY85 DOE SWUs. No buyers are in the market for delivery in the next several months, so the FY85 and FY86 SWU Values have been merged into one indicator. In addition, DOE's incentive pricing offer, to which utilities were supposed to have responded by April 30, contributed to the continuing weakening in the DOE certifiable SWU market.

The lack of activity in the market for other SWUs continued throughout April. European enrichment suppliers devoted effort toward formulating equally attractive alter-

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natives to DOE's incentive pricing campaign. As in the DOE certifiable SWU market, there are virtually no buyers for FY85 SWU, although a few sellers still exist. Negotiations for 1986 deliveries, however, are taking place at present.

The deadline for USEC customers' responses to DOE's incentive pricing program proposal for enrichment passed at the end of April. As of press time, it was impossible to discern a trend in the utility responses. Some customers responded in the form of bids, while others dictated new terms as a contingency for acceptance. As speculated in the last Report, it appears that some customers have submitted bids containing different terms to DOE in order to obtain the best deal possible. Depending on the utility response, DOE may extend the response period past the April 30 deadline. In any case, preliminary reports indicate that DOE did receive enough favorable responses to justify proceeding with the incentive pricing program.

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CURRENT MARKET DATA

April 30, 1985	Market Values	Active Supply[1] (thousands)	Active Demand[1] (thousands)
EXCHANGE VALUE	**\$14.25**/lb. U_3O_8	2,720	1,395
UF_6 VALUE	**\$40.50**/kgU		
CONVERSION VALUE	**\$1.50**/lb. U in UF_6	550	290
SWU VALUES			
DOE origin, certifiable as excess, 0.3 tails assay delivery before the end of FY86	**\$95**/SWU		
Other SWUs (non-DOE or non-certifiable)			
calendar year 1985 delivery	**\$80**/SWU		
calendar year 1986 delivery	**\$85**/SWU		
LOAN USE CHARGE RATE	5%/annum	0	250

	\$/lb. U_3O_8	**Millions of Pounds**	**Number of Transactions**	**Number of Months**
TRANSACTION VALUE	**14.90**	2.9	20	3

[1] Supply and demand tables in the *Current Market Data* section of this Report detail the numbers for each category.

DEFINITIONS

1. The **Exchange Value** is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the date indicated.
2. The **UF_6 Value** is Nuexco's judgment of the price at which spot and near-term transactions for significant quantities of natural uranium hexafluoride could be concluded as of the date indicated.
3. The **Conversion Value** is Nuexco's judgment of the price at which spot and near-term transactions for significant quantities of conversion services could be concluded in the secondary market as of the date indicated.
4. The **SWU Values** represent Nuexco's judgment of the price at which transactions for the sale of significant quantities of SWUs of stated origin for delivery in the specified time period could be concluded as of the date indicated.
5. The **Loan Use Charge Rate** is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the date indicated.
6. The **Transaction Value** is a weighted average price of recent natural uranium sales transactions. The calculation is based on prices paid in:
   a. Transactions closed within the previous three-month period for which delivery is scheduled within one year of the transaction date;
   b. At least ten transactions;
   c. Transactions involving a sum total of at least 2 million pounds U_3O_8 equivalent.

   The sample time is extended as necessary to include these minima. Other currencies are converted to US dollars using conversion rates in effect on or near the transaction date.

DERIVATIONS AND COMMENTS

1. All Market Values are based on:
   a. Data from recently completed transactions.
   b. Data from pending transactions.
   c. Firm bids to buy or borrow, and firm offers to sell or lend.
   d. Prices purchasers or rates borrowers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy or borrow, and prices sellers or rates lenders have expressed a willingness to offer, but for which Nuexco is not aware of firm offers to sell or lend.
2. Prices associated with deliveries under old or renegotiated contracts or other than arm's-length transactions are not considered in the determination of these Market Values.
3. In the determination of the Conversion Value, Nuexco does not consider transportation charges other than those customarily provided by primary suppliers of conversion services.
4. The prices of conversion services or SWUs delivered under long-term contracts with primary suppliers are not considered in the determination of either the Conversion Value or SWU Value.
5. For the DOE SWU Values, Nuexco converts SWU prices at varying tails and product assays to equivalent SWU prices at a tails assay of 0.30 weight-percent U_{235} and a product assay of 3.0 weight-percent U_{235}, assuming feed costs corresponding to the Nuexco Exchange and Conversion Values determined as of the same date.
6. In calculating the Transaction Value, Nuexco does not account for the price of uranium delivered in connection with contracts which call for "market price" mechanisms. This exclusion applies particularly to contracts in which delivery prices are expressed as a function of future Exchange Values or any other indeterminant variable. Also excluded from the calculation are any other transactions in which the delivery price is defined in such a way that it cannot currently be determined.

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EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

	per lb. U_3O_8 in Concentrates			per kg. U in Concentrates		
Country (currency)	**This Month (Apr. 30, 1985)**	**Last Month (Mar. 31, 1985)**	**12 Months Ago (Apr. 30, 1984)**	**This Month (Apr. 30, 1985)**	**Last Month (Mar. 31, 1985)**	**12 Months Ago (Apr. 30, 1984)**
Australia (dollar)	21.72	21.28	19.30	56.47	55.31	50.18
Belgium (comm. franc)	891.18	940.44	973.14	2,317	2,445	2,530
Canada (dollar)	19.49	20.53	22.73	50.66	53.38	59.10
Finland (markka)	92.47	97.66	101.66	240.41	253.88	264.30
France (franc)	135.46	143.13	147.43	352.16	372.11	383.27
FRG (mark)	44.36	46.90	48.01	115.34	121.94	124.82
Italy (lira)	28,274	29,922	29,697	73,506	77,791	77,206
Japan (yen)	3,598	3,793	4,020	9,355	9,860	10,452
Netherlands (guilder)	50.09	52.80	54.12	130.22	137.26	140.69
South Africa (rand)	27.75	28.71	22.12	72.15	74.63	57.50
Spain (peseta)	2,492	2,610	2,696	6,479	6,786	7,010
Sweden (krona)	128.49	135.01	141.21	334.06	351.00	367.11
Switzerland (franc)	37.23	38.88	39.64	96.78	101.08	103.05
UK (pound)	11.58	12.20	12.66	30.10	31.72	32.90
US (dollar)	14.25	15.00	17.75	37.05	39.00	46.15

TRANSACTION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

	per lb. U_3O_8 in Concentrates			per kg. U in Concentrates		
Country (currency)	**This Month (Apr. 30, 1985)**	**Last Month (Mar. 31, 1985)**	**12 Months Ago (Apr. 30, 1984)**	**This Month (Apr. 30, 1985)**	**Last Month (Mar. 31, 1985)**	**12 Months Ago (Apr. 30, 1984)**
Australia (dollar)	22.71	21.35	19.46	59.05	55.50	50.60
Belgium (comm. franc)	931.83	943.57	981.36	2,423	2,453	2,551
Canada (dollar)	20.37	20.60	22.93	52.97	53.56	59.60
Finland (markka)	96.69	97.98	102.52	251.37	254.73	266.53
France (franc)	141.64	143.61	148.67	368.22	373.35	386.51
FRG (mark)	46.39	47.06	48.42	120.60	122.35	125.87
Italy (lira)	29,563	30,022	29,948	76,858	78,050	77,858
Japan (yen)	3,763	3,805	4,054	9,782	9,893	10,540
Netherlands (guilder)	52.37	52.97	54.57	136.16	137.72	141.88
South Africa (rand)	29.02	28.80	22.31	75.44	74.88	57.99
Spain (peseta)	2,606	2,619	2,719	6,775	6,808	7,069
Sweden (krona)	134.36	135.46	142.40	349.29	352.17	370.21
Switzerland (franc)	38.92	39.01	39.97	101.19	101.42	103.92
UK (pound)	12.10	12.24	12.76	31.47	31.82	33.18
US (dollar)	14.90	15.05	17.90	38.74	39.13	46.54

[1] Calculated using currency exchange rates published in the *Wall Street Journal* on April 30, 1985.

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CURRENT MARKET DATA

CONVERSION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb. U as UF_6 This Month (Apr. 30, 1985)	per lb. U as UF_6 Last Month (Mar. 31, 1985)	per lb. U as UF_6 12 Months Ago (Apr. 30, 1984)	per kg. U as UF_6 This Month (Apr. 30, 1985)	per kg. U as UF_6 Last Month (Mar. 31, 1985)	per kg. U as UF_6 12 Months Ago (Apr. 30, 1984)
Australia (dollar)	2.29	1.42	0.87	5.04	3.13	1.92
Belgium (comm. franc)	93.81	62.70	43.86	206.81	138.22	96.69
Canada (dollar)	2.05	1.37	1.02	4.52	3.02	2.26
Finland (markka)	9.73	6.51	4.58	21.46	14.35	10.10
France (franc)	14.26	9.54	6.64	31.43	21.04	14.65
FRG (mark)	4.67	3.13	2.16	10.30	6.89	4.77
Italy (lira)	2,976	1,995	1,338	6,561	4,398	2,951
Japan (yen)	378.79	252.84	181.20	835.08	557.43	399.48
Netherlands (guilder)	5.27	3.52	2.44	11.62	7.76	5.38
South Africa (rand)	2.92	1.91	1.00	6.44	4.22	2.20
Spain (peseta)	262.33	174.00	121.53	578.34	383.61	267.92
Sweden (krona)	13.53	9.00	6.36	29.82	19.84	14.03
Switzerland (franc)	3.92	2.59	1.79	8.64	5.71	3.94
UK (pound)	1.22	0.81	0.57	2.69	1.79	1.26
US (dollar)	1.50	1.00	0.80	3.31	2.20	1.76

SWU VALUES AND UF_6 VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	DOE SWU Delivery by the End of FY86 (April 30, 1985)	Non-DOE SWU 1985 Delivery (April 30, 1985)	Non-DOE SWU 1986 Delivery (April 30, 1985)	UF_6 per kg. U in UF_6 This Month (April 30, 1985)
Australia (dollar)	144.82	121.95	129.57	61.74
Belgium (comm. franc)	5,941	5,003	5,316	2,533
Canada (dollar)	129.91	109.39	116.23	55.38
Finland (markka)	616.48	519.14	551.59	262.82
France (franc)	903.04	760.46	807.98	384.98
FRG (mark)	295.77	249.07	264.63	126.09
Italy (lira)	188,492	158,730	168,651	80,357
Japan (yen)	23,990	20,202	21,465	10,227
Netherlands (guilder)	333.92	281.20	298.77	142.36
South Africa (rand)	185.00	155.79	165.53	78.87
Spain (peseta)	16,614	13,991	14,865	7,083
Sweden (krona)	856.63	721.37	766.46	365.19
Switzerland (franc)	248.17	208.99	222.05	105.80
UK (pound)	77.17	64.99	69.05	32.90
US (dollar)	95.00	80.00	85.00	40.50

[1] Calculated using currency exchange rates published in the *Wall Street Journal* on April 30, 1985.

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RECENT TRANSACTIONS[1]

Uranium Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U_3O_8 equivalent)	Approximate Price as Percent of Current E.V.	Seller	Buyer	Remarks
3413	1985	1,001-1,500	R[5]	US Producer	R[5]	
3412	1985	101-300	100	Trader	Trader	UF_6.
3411	1985	101-300	98	Trader	US Utility	UF_6.
3409	1985	less than 50	99	US Producer	Trader	
3408	1985	101-300	101	US Producer	US Producer	

Enrichment Services
Secondary Market Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity[2] (thousands of SWUs)	Approximate Price[3] as Percent of Current SWU Value[4]	Seller Group	Buyer Group	SWU Origin	Remarks
3392	1985	less than 50	R[5]	US Utility	Trader	DOE	Tails assay swap; occurred in early 1985.

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[1] Transactions listed are not limited to those in which Nuexco was involved, but also include others of which Nuexco is aware.

[2] If tails assay is unknown or unspecified, Nuexco's calculation of SWU quantity assumes 0.30 w/o tails assay.

[3] Price is not normalized to 0.30% tails assay.

[4] Refers to SWU Value that corresponds to SWUs included in transaction. When prices and SWU values are expressed as discounts (e.g., X dollars less than DOE's USEC base price at time of delivery), the percentage refers to the ratio of the *discounts*, not the ratio of the prices.

[5] The notation *R* means that Nuexco either does not know, or that Nuexco has restricted that information to protect client confidentiality.

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CURRENT MARKET DATA

URANIUM SUPPLY
(April 30, 1985)

	Delivery Period[1] (Thousands of Pounds U_3O_8)		
Nuexco Project Number	**Spot or Near-term[2]**	**Intermediate or Long-term**	**Remarks**
Available for Sale:			
ACTIVE			
1575	500	500 per year	
1860	400	1,500 per year	
2134*	220	220 per year	1985-87
2389*	300	—	
2392	35	—	UF_6
2510*	980	—	UF_6
2538*	30	—	
2594*	20	20 per year	1985-90
2675	35	—	UF_6
2705A*	200	—	UF_6
2263*	—	500 per year	1987-90
2625	—	250 per year	1987-89
2680	—	250 per year	1986-92
TOTAL:	2,720		
INACTIVE			
2191	125	—	UF_6
2335	275	—	
2336	250	250 per year	1985-94
2553	300	—	
2654	250	250 per year	UF_6
2297	—	200 per year	1986-89
2670	—	525	1987
TOTAL:	1,200		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2271, 2275, 2368, 2495, 2565, 2574, 2584, 2633, 2657.

URANIUM DEMAND
(April 30, 1985)

	Delivery Period[1] (Thousands of Pounds U_3O_8)		
Nuexco Project Number	Spot or Near-term[2]	Intermediate or Long-term	Remarks
Inquiries to Purchase:			
ACTIVE			
2548	290	—	
2590	75	—	U_3O_8 or UF_6
2636	100	—	
2674	800	—	
2699*	130	—	U_3O_8 or UF_6
2217	—	1,000 per year	1989-95
2507	—	600	1987-89
2681	—	1,000 per year	1987-88
2748*	—	75 per year	1986-90
TOTAL:	1,395		
INACTIVE			
2576	20	—	UF_6
2695*	1,250	—	UF_6
2414	—	365	1987-88
2457B	—	650	1987
2586	—	300	1987
2643	—	150 per year	1987 on
2694*	—	625	1987; UF_6
TOTAL:	1,270		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.
Projects removed since last month: 2244, 2419, 2442, 2540, 2574B, 2611, 2659, 2661, 2676, 2690, 2995.

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CURRENT MARKET DATA

LOAN SUPPLY AND DEMAND
(April 30, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8)		Remarks
	Within 1 Year	Beyond 1 Year	
Available for Loan: **INACTIVE**			
1938	2,000	—	UF_6
2139	2,000	—	
2469A	800	—	
2483	550	—	
2667	800	—	
TOTAL:	6,150		
Inquiries to Borrow: **ACTIVE**			
2606*	250	—	
TOTAL:	250		

*New or revised since last month.
[1] Measured from the date of this Report.
Projects removed since last month: 2128.

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CONVERSION SUPPLY AND DEMAND
(April 30, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U as UFs)		Remarks
	Within 3 Years	Beyond 3 Years	
Available for Sale:			
ACTIVE			
1936*	440	550	1986-89
2051	110	—	
TOTAL:	550		
INACTIVE			
2438	500	250 per year	1986-87
2511	600	700	1986-90
TOTAL:	1,100		
Inquiries to Purchase:			
ACTIVE			
2419A	55	—	
2587*	35	—	
2602	200	—	
2617	—	275	1986-91
TOTAL:	290		
INACTIVE			
2529	225	—	
2644	—	475	1987 on
2724*	—	375	1989-93
TOTAL:	225		

*New or revised since last month.

[1] Measured from the date of this Report.

Projects removed since last month: None.

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CURRENT MARKET DATA

SWU SUPPLY AND DEMAND
(April 30, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of SWUs) Spot or Near-term[2]	Intermediate or Long-term	Remarks
Available for Sale:			
ACTIVE			
2624	100	—	
2633B	330	—	
2705*	40	—	
2359	—	200	
2517	—	155	1986-89
2571	—	55	1987
2684*	—	35	
TOTAL:	470		
INACTIVE			
2164	20	—	
2378	—	120	1988
265[illegible]	—	25	1986
TOTAL:	20		
Inquiries to Purchase:			
ACTIVE			
2655	10	—	
2713*	180	—	
2400	—	150	1987-90
2519	—	30 per year	1987 on
2653	—	100	1986-90
2658	—	5	1986
TOTAL:	190		
INACTIVE			
2543	25	25	1986
2585	—	40	1986
2500	—	170	1988
2512	—	15 per year	1987 on
2595	—	50	1986
2693	—	100 per year	1989-90
TOTAL:	25		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes SWUs deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2100, 2285, 2510, 2513, 2578, 2631, 2664.

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THE AVLIS ENRICHMENT PROCESS

Introduction

DOE soon will decide which new technology will become the primary method used by the US enrichment program. DOE's customer base has diminished over the last three years in the face of increased competition from European enrichers and secondary market SWU sales, just as it launched a vast development and construction program amounting to billions of dollars. DOE has decided that it can no longer afford to fund two research and development programs in its effort to develop an advanced enrichment technology that will produce lower-cost SWUs. Although DOE previously wanted to select the new technology in 1988, its poor financial condition resulting from canceled enrichment contracts and high penalties for unneeded long-term contracts for electricity to run the plants dictated that the decision be made as soon as May 1985.

The two technologies under consideration are the Gas Centrifuge Enrichment Plant (GCEP), with a production facility based on current technology already under construction at Portsmouth, Ohio, and the Atomic Vapor Laser Isotope Separation process (AVLIS), under development at the Lawrence Livermore National Laboratory in Livermore, California. Increasing electricity and operational costs for gaseous diffusion, the process currently in use for all of DOE's commercial enrichment, have made DOE's prices uncompetitive with non-US enrichers, and it is probable that DOE will choose either GCEP or AVLIS as the future US enrichment technology. DOE recently decided to delay for two years the completion of the 13.2 million SWU per year GCEP plant. Should DOE decide to proceed with the centrifuge technology, the two-year delay would allow for better cash flow and SWU demand projections. (For a discussion of the gas centrifuge process, see the article on Urenco in Report 191, June 1984.)

Enrichment Technologies

The commercial technologies employed by the world's enrichers are based on exploiting the small differences in mass between the two most common uranium isotopes. The lighter, fissionable U_{235} atoms, 0.711 percent of natural uranium, are separated from the slightly heavier U_{238} atoms by either gaseous diffusion or gas centrifugation.

Gaseous diffusion operates on the principle that the lighter U_{235} atoms will travel through a cascade of porous barriers faster than the U_{238} atoms. In equilibrium, all molecules will have the same kinetic energy distribution. Because $U_{235}F_6$ is slightly faster ($E_0 = \frac{1}{2} M_1V_1^2$) than $U_{238}F_6$ ($E_0 = \frac{1}{2} M_2V_2^2$), it will strike the porous barrier more often than $U_{238}F_6$, and thus will have a slightly higher probability (approximately 1.0012:1) of penetrating the porous barrier than will the $U_{238}F_6$. Since the probability differential for any one barrier is so small, many stages are required to achieve significant enrichment. About 1,250 stages are necessary for 3-percent U_{235} enrichment. Thus, diffusion is a very energy-intensive process, requiring large plants and high electricity consumption. US DOE, Eurodif, and Techsnabexport (USSR) utilize gaseous diffusion plants.

Gas centrifugation also exploits the difference in mass, using a rotating cylinder to spin the heavier U_{238} isotope to the outer walls so that the U_{235} can be drawn out of the middle of the cylinder. This process requires significantly less power per unit of output, and gas centrifugation has an advantage in that capacity can be added in smaller increments, thereby lessening the capital risk. Urenco, which operates three gas centrifuge plants, has a present capacity of 1.4 million SWU per year, which is scheduled to be increased to 2 million SWU per year by 1987-88. Should new orders arrive, further capacity will be added, reaching 3 million SWU per year by 1990.

AVLIS is based on a fundamentally different concept than the other methods. Different isotopes of the same element, though chemically identical, have different electron energy levels. As a result, different frequencies or colors of light are absorbed by each isotope, giving it a distinct color signature (Figure 1). AVLIS exploits the different quantum energy absorption properties of the different isotopes (not necessarily uranium). When a high-energy laser beam tuned to the precise frequency passes through elemental uranium in a vapor state, the photons excite the electrons of only the selected U_{235} isotope, a process known as photoionization. The U_{235} atom emits an electron and becomes a positively charged ion. The ion then can be separated electromagnetically (Figure 2).

While full production capabilities have not been demonstrated, AVLIS has several inherent advantages over the other processes.

1. High isotopic selectivity provides full enrichment (from 0.7 percent U_{235} to 3.2 percent U_{235}) in a single step, achieving a very high throughput per equipment module.

2. Because of its fundamental selectivity advantage over diffusion and centrifugation, for a given capacity AVLIS requires less equipment and electricity, and a sig-

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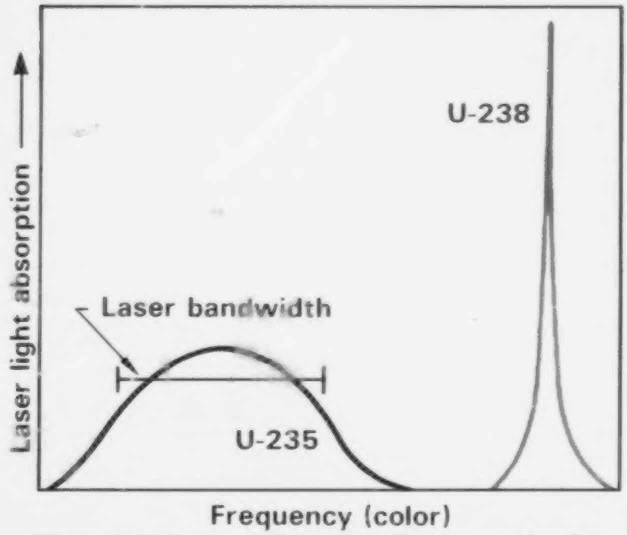

Figure 1: Light absorption spectra for two uranium isotopes, illustrating that by properly tuning a laser system, one isotope (U_{235}) can be selected for photoionization and extraction, to the exclusion of the other (U_{238}).

nificantly smaller plant, than the other technologies. This results in lower capital and operating costs.

History of AVLIS

In the early 1970s, many ideas for separating isotopes were present in the scientific community. The applications of isotope separation included military, industrial, medical, and commercial uses as well as that of uranium enrichment. Los Alamos National Laboratory was developing a molecular UF_6 laser separation process, (MLIS), and a plasma separation process (PSP) was under exploration at TRW in California. In addition, Exxon Nuclear and AVCO-Everett Research Lab conducted research in the atomic uranium process through a jointly-owned subsidiary, Jersey Nuclear-AVCO Isotopes, Inc. (JNAI). The program initiated at Lawrence Livermore National Lab (LLNL) in 1973 under contract from DOE was designed to improve the economics of isotope separation. DOE had assigned LLNL the task of evaluating alternative processes to those under development by Los Alamos and JNAI. LLNL chose to explore the various technology options for atomic uranium vapor separation. When the program was in the developmental stages, research aimed at scientific rather than economic feasibility, but early successes allowed researchers to focus on the overall objective of low-cost enrichment.

In 1974, scientists succeeded in separating U_{235} by means of a two-step photoionization technique, which was followed by the separation of milligram quantities of reactor-grade U_{235} in early 1975. Atomic uranium vapor was produced by heating uranium metal in a water-cooled copper crucible with an electron beam in order to achieve the extremely high temperature needed for vaporization. Part of the development effort throughout the 1970s aimed at solving the problems associated with producing industrial-scale quantities of uranium vapor, which is corrosive at such high temperatures, and has an extremely low vapor pressure. It also was necessary to develop a separation chamber that could direct the rapidly-moving vapor stream toward a laser and onto separate collector plates for the product and waste material.

Laser Technology

Much of the AVLIS research at LLNL over the past decade focused on laser technology requirements. Study ranged from the accuracy of frequency and pulse generation to the large-scale engineering required for industrial use. Scientists experimented with various laser sources, such as xenon-chloride and krypton-fluoride lasers, and finally in 1979 chose copper vapor lasers pumped through dye process lasers as the system to generate the proper color and power for U_{235} photoionization. Because of a high pulse repetition frequency and its generation of visible light instead of ultraviolet, the copper vapor laser proved to be the preferred means of photoionization. The laser is self-contained, utilizing its waste discharge heat to maintain the copper vapor in a gaseous state. In addition, the structure of the laser-pumped dye system allows the construction of high average power systems which can achieve high system availability and relatively long operational periods.

Figure 3 is a simplified diagram of the laser module. The process dye laser consists of master oscillator/power-amplifier chains. The master oscillator generates the precise color and pulse shape needed for the application, and the amplifiers increase the beam power. The copper vapor lasers serve as the pump laser, energizing the process dye lasers. The dye lasers pass through a flow channel containing dye dissolved in alcohol. The green copper vapor pump laser penetrates the flowing dye solution, and the red-orange process lasers are beamed through the dye, removing the energy deposited by the pump laser. Hence, energy from the pump laser amplifies the precisely-tuned red-orange process beam.

Because the dyes can absorb and re-emit light over all the shades of red and orange in a given dye, the precise

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color signature is made in the oscillator. The process beam then passes through successive dye amplification stages to increase its power. The amplifiers have no color selectivity, and will amplify any color within the dye bandwidth.

Separator Module

The separator consists of a large tank that houses the vaporizer and the collection plates (Figure 4). LLNL has been testing a half-scale separator since 1981, and the full-scale demonstration model is approaching completion. The Separator Demonstration Facility is scheduled to begin operation in 1986, and production-cycle demonstrations are scheduled for early 1987. It will be capable of enriching at the rate of approximately one million SWU per year. The objective of the separator development program has been to achieve an economical separator module, including maximum energy efficiency and durable mechanical components under high temperatures. In the current design, full enrichment from 0.7 percent U_{235} to 3.2 percent U_{235} is achieved in a single pass through the separator. Thus, for each six kilograms of unenriched uranium feed, the module produces one kilogram of enriched product in one pass.

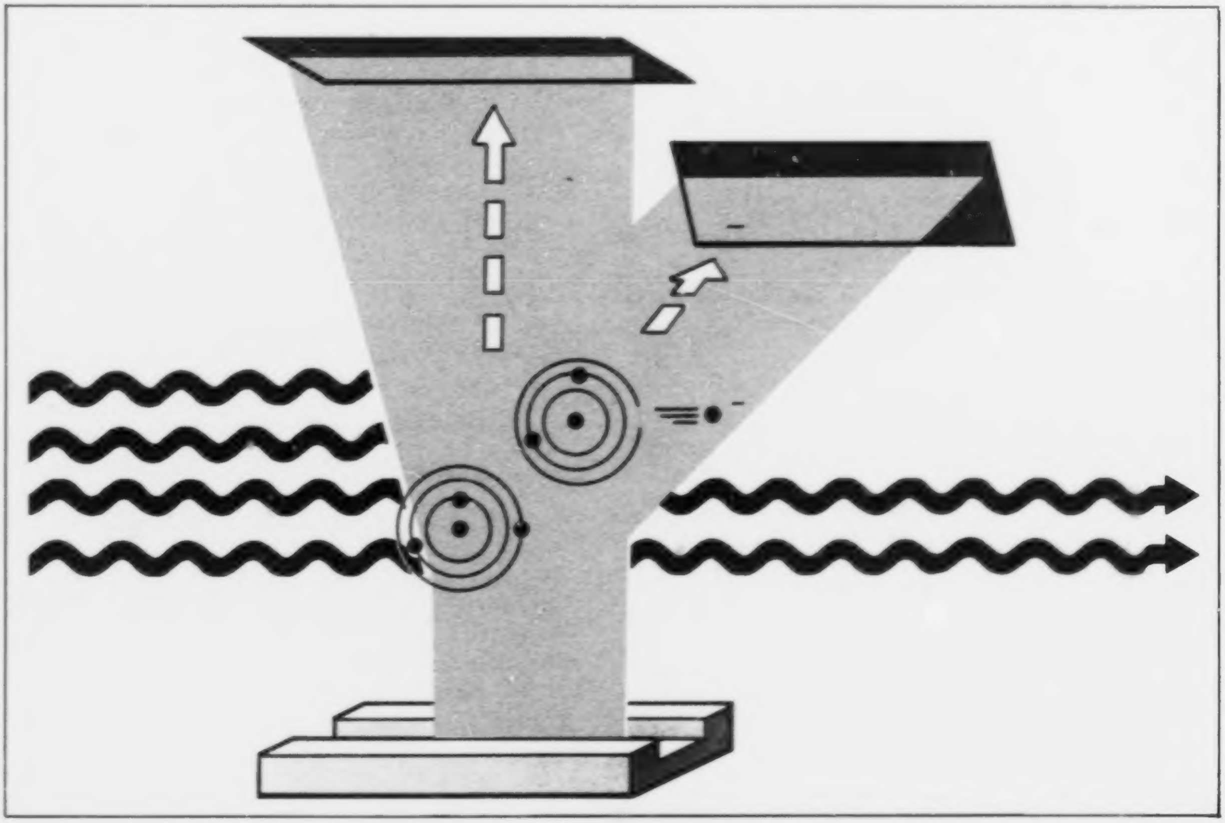

Figure 2: AVLIS schematic representation for two isotopes of uranium. The red laser light is tuned to electron energy levels of U_{235}, but not U_{238}. The U_{235} atom absorbs the precisely-color-tuned laser energy and ejects an electron (photoionization). The U_{235} atom left with a net positive charge is diverted by an electromagnetic field, while neutral U_{238} moves on unaffected.

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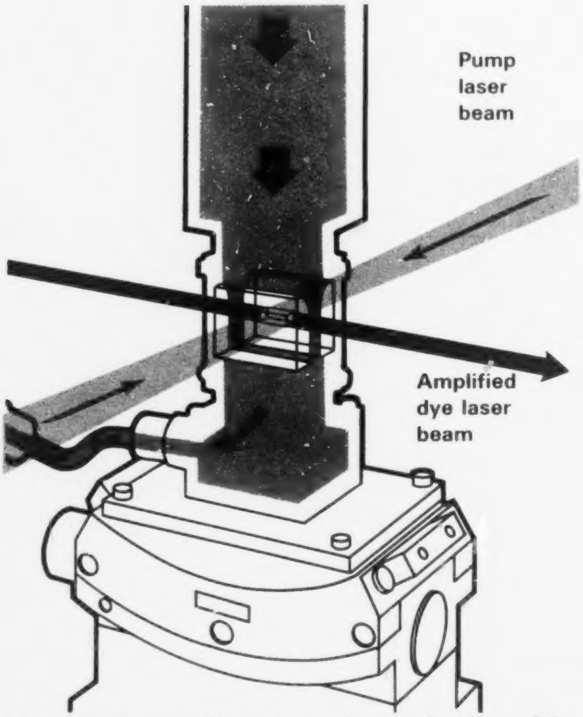

Figure 3: Dye amplifier schematic, showing flow of dye stream and intersection of dye and pump laser beams in a small flow channel.

Demonstration Facility

The Separator Demonstration Facility is part of the AVLIS Full-Scale Demonstration Facility now under construction at Livermore. It will be a plant-scale system, the prototype for commercial development of AVLIS. The plant has the capability to convert natural UF_6 to uranium metal, and convert the enriched metal back to UF_6 after vaporization. Operations procedures and personnel training techniques will be developed in the facility. At present, the objective of the facility is to firmly establish AVLIS capital and operating costs, and technology improvements are expected as the plant becomes operational. If DOE chooses AVLIS as its primary enrichment technology for the future, it may decide to use the demonstration facility for training personnel or to solicit commercial and industrial participation. DOE may consider private-company participation in the development, operation, financing and ownership of AVLIS projects outside of the LLNL facility.

Ownership alternatives range from full government ownership and funding to a direct transfer to the private sector. A number of issues that would have to be resolved before a direct transfer would be possible include regulation and licensing under the Atomic Energy Act of 1954 and the Nuclear Regulatory Commission (NRC). A joint venture between DOE and a private company could avoid some of those restrictions. Nevertheless, some kind of congressional approval probably would be required. A phased transfer is a more likely scenario. In this approach, AVLIS would be developed as a commercial project with significant DOE involvement. Sponsor companies would structure the financial and commercial arrangements, and manage the engineering and construction of the project. Then, depending on the agreement reached, the facility could be sold to one or more private company bidders, or DOE could assume ownership and let the sponsor group continue to run the plant, or find a new operator. There are many possible alternatives, and the details are contingent on DOE's decision in May on whether to emphasize AVLIS.

Although the effort at LLNL has been directed toward uranium enrichment and the DOE decision, the technology is capable of a range of commercial applications in isotope separation. The isotopes of most elements can be separated by lasers. For example, increasing the percentage of mercury-196 in fluorescent lamps substantially improves their efficiency. Isolating gadolinium isotopes for fuel rods and the removal of useful isotopes from spent fuel are other possible laser isotope separation applications in nuclear power.

Enrichment Cost

Cost comparisons between AVLIS and GCEP are complicated by insufficient demonstration and capital cost data, in addition to the impact of variables such as monitoring and regulation costs which are as yet uncertain. However, proponents of the AVLIS system have concluded that lower production costs will allow DOE to lower the price of enrichment to compete with other enrichers, while also permitting full cost recovery. Future SWU costs depend on market conditions, production costs, future demand, capacity increases and technological advances. LLNL's estimates for AVLIS SWU costs depend on the size of the plant, when it is deployed, and many other considerations. LLNL recently submitted to DOE's Process Evaluation Board a projected figure of $49 per SWU. Proponents of the GCEP dispute that figure, and reliable cost projections probably will not be available until the Demonstration Facility reaches full operation in 1987.

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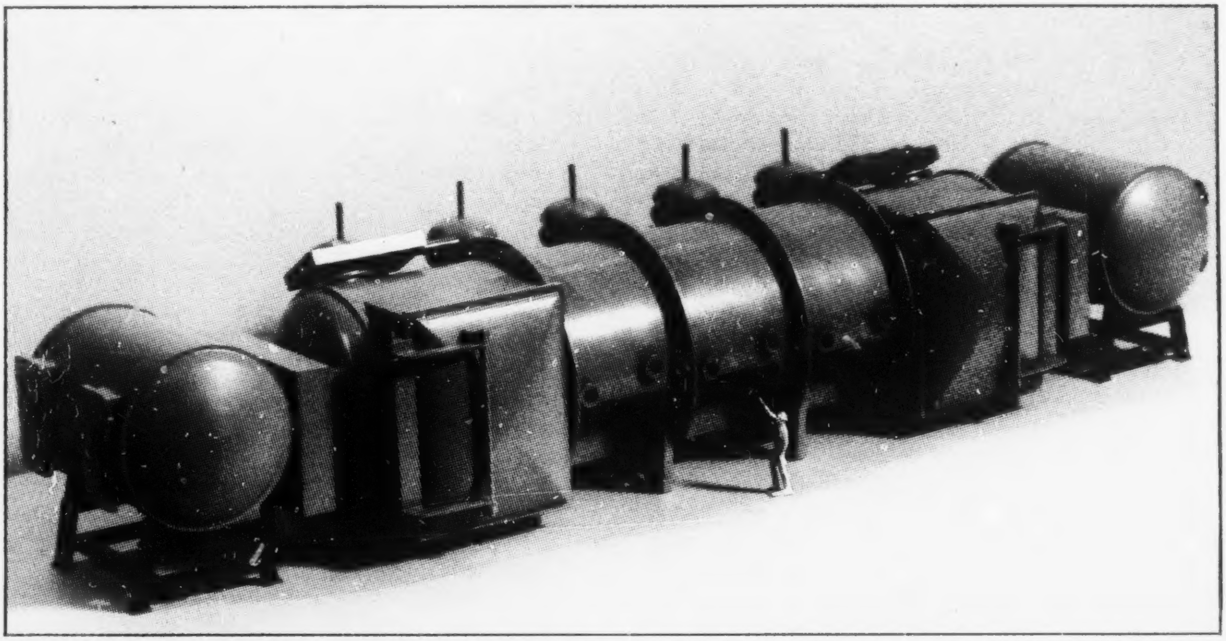
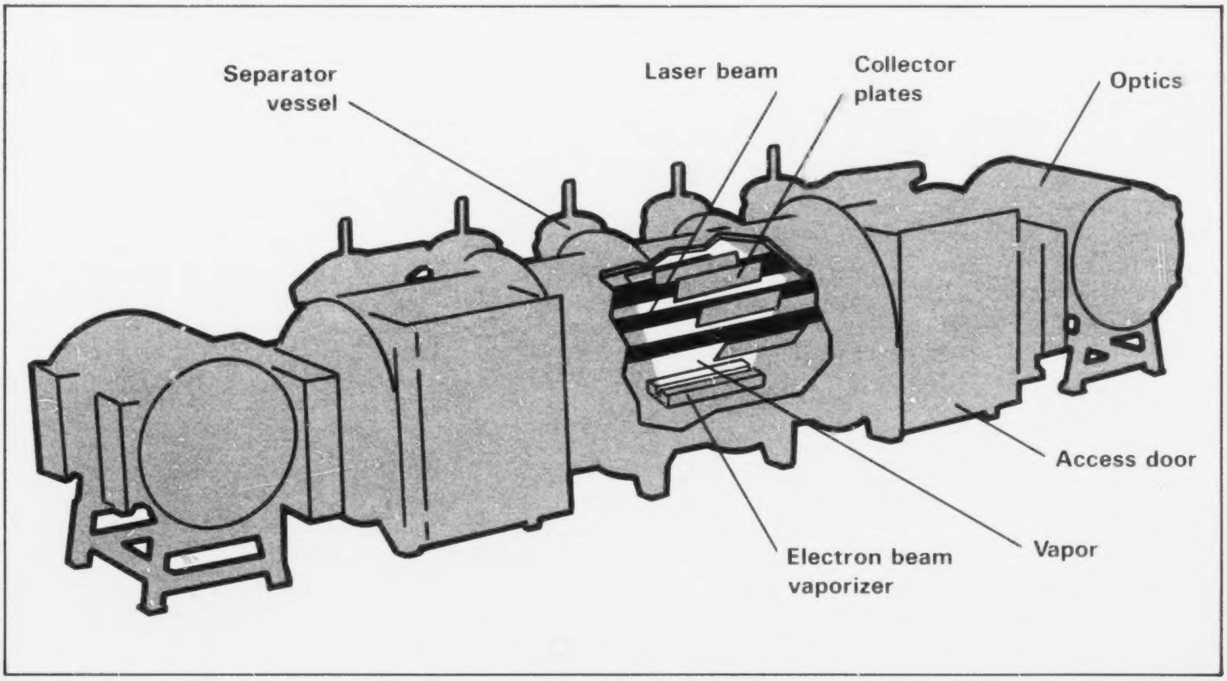


Figure 4: The Separator Demonstration Module (above), currently under construction at LLNL, is scheduled for activation in 1985-86. The schematic below shows the primary internal parts of the separator module in the LLNL Full-Scale Demonstration Facility.


Separator vessel
Laser beam
Collector plates
Optics
Access door
Vapor
Electron beam vaporizer

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SOUTH AFRICA

First-quarter 1985 uranium production from Chamber of Mines producers totaled 3,145,000 pounds U_3O_8, a seven-percent decline from the fourth quarter of 1984 (Table 1). Production was 22 percent less than the 3,848,000 pounds U_3O_8 produced in the first quarter of 1984. Some specific comments on various production sites are as follows.

1. There was no production this quarter from Blyvooruitzicht or Beisa (St. Helena), both of which ceased operations in the fourth quarter of 1984.
2. Significant production declines occurred at Dreifontein Consolidated (26 percent), JMS (Free State Joint Metallurgical Scheme) (22 percent), and Western Deep Levels (20 percent). Most of these declines stemmed from decreased throughput and yield, and are likely to persist as long as uranium market conditions remain unfavorable.
3. Production fell 46 percent at Chemwes (Stilfontein) due to a 40-percent cutback in tons treated and an 11-percent decline in yield. The Chairman of Stilfontein, Mr. J.C. Fritz, stated in his annual review of March 8, 1985, that production has been provisionally reduced to 60 percent of capacity due to reduced current demand. Negotiations with the mine's primary customer are continuing and the outcome will be announced as soon as a conclusion is reached.
4. Production increased ten percent at Vaal Reefs due to a higher tonnage throughput, and increased eight percent at Buffelsfontein due to an increase in yield and tons treated.

Mr. E.P. Gush, Chairman of Vaal Reefs and Western Deep Levels, stated the following in his annual reviews dated March 11, 1985:

"In the uranium market, increased production in Canada more than offset the production cutbacks elsewhere, especially in the United States. Supply from production as well as inventory liquidation exceeded utilities' requirements during the year. This, together with aggressive sales programmes from certain large, low-cost producers served to reverse the modest improvement of spot-market prices seen in 1983 and to push prices to their lowest level in more than ten years."

"The short-to-medium-term outlook for the uranium market has also deteriorated with the introduction by the United States Department of Energy of a revised enrichment contract. The effect of this more competitive contract will be to postpone enrichment feed requirements and consequently the demand for uranium."

Table 1

REPUBLIC OF SOUTH AFRICA: RECENT URANIUM PRODUCTION[1]
(Thousands of pounds U_3O_8)

Operation	Fourth Quarter 1984	Total 1984	First Quarter 1985
Beisa (St. Helena)	16	794	0
Blyvooruitzicht	85	514	0
Buffelsfontein	371	1,352	401
Chemwes (Stilfontein)	276	1,155	148
Dreifontein Consolidated	61	351	45
ERGO[2]	84	362	83
Harmony	255	1,095	256
Hartebeestfontein	237	963	239
JMS[3]	402	1,316	314
Randfontein	297	1,306	291
Vaal Reefs	1,052	4,328	1,156
Western Areas	163	673	150
Western Deep Levels	78	322	62
TOTAL	3,377	14,531	3,145

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[1] Excludes Palabora Mining Company, which is not a member of the Chamber of Mines.
[2] ERGO = East Rand Gold and Uranium Co. Ltd.
[3] JMS = Free State Joint Metallurgical Scheme.

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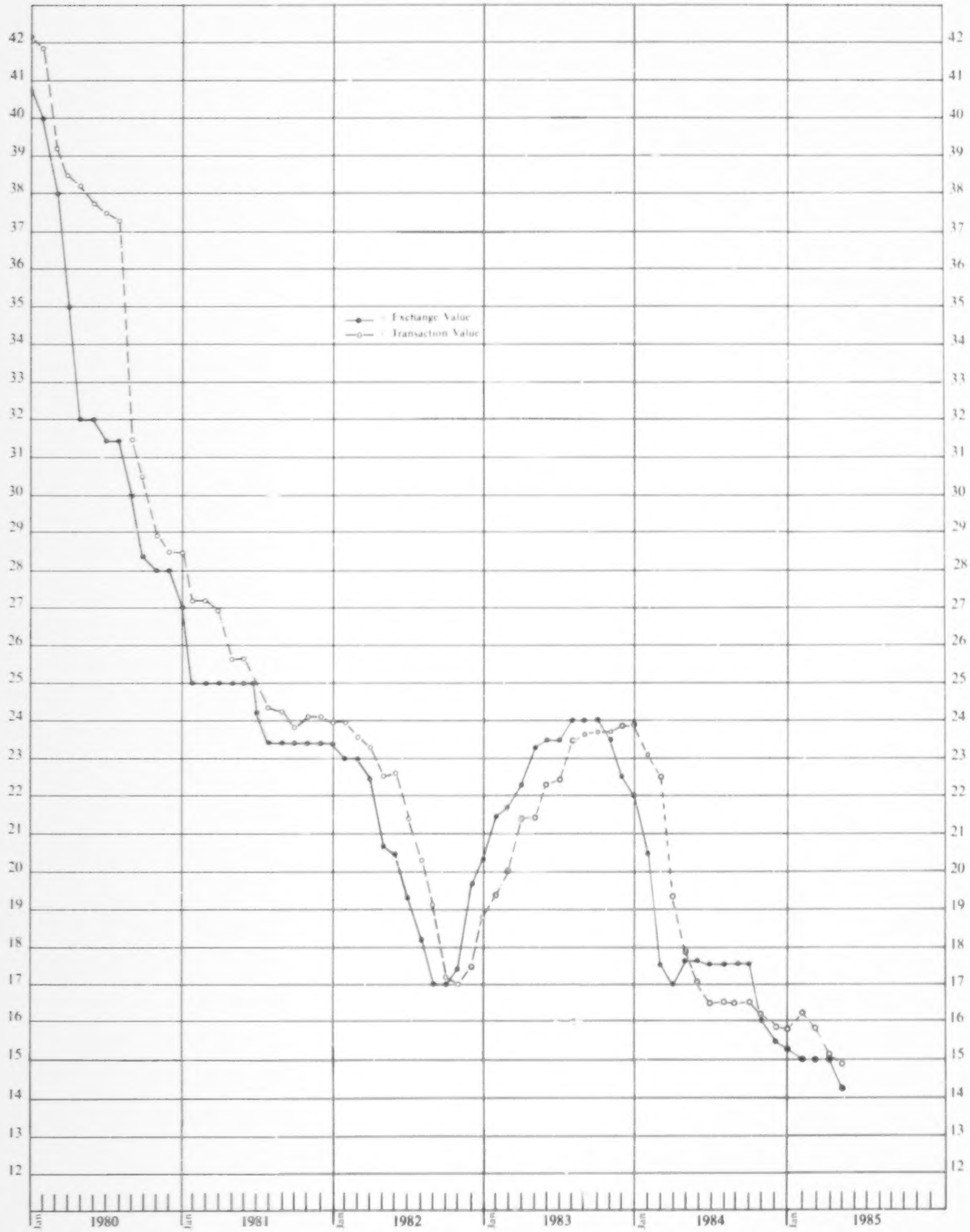
HISTORICAL MARKET DATA

EXCHANGE AND TRANSACTION VALUES
SINCE JANUARY 1980

Determined as of the last day of the month indicated



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HISTORICAL MARKET DATA

HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	—	—	—	—	—	—	—	6.35	6.35	6.40	6.45	6.50
1969	—	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	32.50	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00
1981	25.00	25.00	25.00	25.00	25.00	24.25	23.50	23.50	23.50	23.50	23.50	23.50
1982	23.00	23.00	22.50	20.75	20.50	19.25	18.25	17.00	17.00	17.50	19.75	20.25
1983	21.50	21.75	22.25	23.25	23.50	23.50	24.00	24.00	24.00	23.50	22.50	22.00
1984	20.50	17.50	17.00	17.75	17.75	17.50	17.50	17.50	17.50	16.00	15.50	15.25
1985	15.00	15.00	15.00	**14.25**								

HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	—	—	—	—	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38.40	37.90	37.60	37.30	31.60	30.60	29.00	28.70	27.70
1981	27.20	27.20	27.00	25.70	25.70	24.50	24.40	24.30	23.90	24.10	24.10	24.00
1982	24.00	23.70	23.40	22.60	22.70	21.50	20.30	19.10	17.30	17.00	17.55	18.80
1983	19.35	20.00	21.35	21.40	22.35	22.45	23.50	23.60	23.65	23.65	23.85	23.85
1984	23.05	22.50	19.25	17.90	17.00	16.50	16.60	16.40	16.55	16.05	15.90	15.90
1985	16.20	15.70	15.05	**14.90**								

HISTORICAL CONVERSION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U as UF_6)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	1.20	1.20	1.20	1.40	1.15	1.15	1.15	1.10	1.10	1.10	1.20	1.20
1982	1.20	1.20	1.20	1.20	1.00	1.00	1.00	0.90	1.10	1.60	1.45	1.45
1983	1.20	1.40	1.40	1.20	1.20	1.20	1.10	1.10	1.00	0.60	0.60	0.60
1984	0.60	0.30	0.80	0.80	0.80	0.00	0.00	0.80	1.00	1.00	0.80	0.80
1985	1.00	1.00	1.00	**1.50**								

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AUSTRALIA

	Price Index of Materials Used in Manufacturing Industry—All Groups[1] (1969=100)	Award Rates of Pay Indexes Australia—Adult Males In Mining Wage and Salary Earners, Weekly Rates[2] (1976=100)
1983 Avg.	401.2	181.8
Jan 1984	399.2	188.6
Feb 1984	402.5	188.5
Mar 1984	403.9	188.3
Apr 1984	404.2	196.2
May 1984	403.8	197.0
Jun 1984	404.9	197.0
Jul 1984	408.5	197.0
Aug 1984	413.3	197.0
Sep 1984	412.1	197.0
Oct 1984	408.6	197.0
Nov 1984	407.3R	197.0
Dec 1984	406.0	197.0
Jan 1985	409.3	197.0
Feb 1985	—	197.0

P = Preliminary R = Revised since last month

CANADA

		Wage-earner Data: Average Hourly Earnings (C$)[2]					
	Industry Selling Price Index: Manufacturing[1] (1971=100)	Uranium Mines (SIC 057)	Metal Mines* (SIC 051-059)	Mines, Quarries and Oil Wells[3] (SIC 051-099)	Primary Metal Industries Non-ferrous[4] (SIC 296)	Primary Metal Industries Non-ferrous[4] (SIC 298)	Chemicals and Chemical Products[5] (SIC 372-379)
1983 Avg.	298.8	—	—**	14.30	—	—	11.17
Jan 1984	305.4	17.74	15.27	14.74	11.91	10.84	11.69
Feb 1984	306.6	17.78	15.59	14.90	12.04	10.82	11.51
Mar 1984	308.7	18.05	15.52	14.82	12.14	10.84	11.58
Apr 1984	310.5	18.06	15.83	15.10	11.96	10.34	11.63
May 1984	310.6	18.48	15.64	15.06	12.11	10.16	11.65
Jun 1984	311.0	18.08	15.48	14.80	12.38	10.40	11.66
Jul 1984	312.7	17.81	15.72	14.92	12.53	10.18	11.82
Aug 1984	312.7	17.24	15.36	14.92	12.44	10.34	11.78
Sep 1984	312.3	17.68	15.96	15.34	12.51	10.52	11.90
Oct 1984	312.3	17.64	16.15	15.26	12.69	10.56	11.96
Nov 1984	313.6	18.04	16.13	15.43	12.47	10.51	11.96
Dec 1984	314.2	17.95	16.39	15.60	12.16	10.40	11.99
Jan 1985	315.8R	18.05R	16.13R	15.60R	12.32	10.80R	12.04R
Feb 1985	316.4R	18.74P	16.40P	15.71P	12.55P	11.13P	11.99P
Mar 1985	317.5P	—	—	—	—	—	—

P = Preliminary R = Revised since last month

For annual averages prior to 1983, and for notes pertaining to these statistics, see pages 23-26 of Report 190 of June 1984.

*The 1980 average for Metal Mines was incorrectly reported as 10.59. The correct average is 10.58 (see Report 190).

**Two different methods were used in the 1983 "Metal Mines" category in reporting survey data, and Statistics Canada did not publish a 1983 average. The March 1983 figure for the old method was 14.73 and for the new method was 14.84. The published average for 1983 in Report 190 was a Nuexco calculation based on the available monthly statistics for 1983 with the exception of the March figure, where only the 14.84 value was taken into account.

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GOVERNMENT STATISTICS

REPUBLIC OF SOUTH AFRICA

	Average Declared Working Costs per per Metric Ton of Gold Ore Milled (Rand)[1]	Tonnage-Weighted Index of Average Working Costs per Metric Ton of Gold Ore Milled (March 1982=100)[2]	Consumer Price Index[3] (1975=100)[4]	Producer Price Index All Groups[5] (1975=100)	Total Employment in Mining and Quarrying (Code 35)[6]	Total Salaries and Wages in Mining and Quarrying (1,000 Rand) (Code 40)[6]
1983 Avg.	51.87	115.0	262.2	274.8	696,579	3,644,772
Jan 1984	—	—	274.7	283.3	689,807	326,619
Feb 1984	—	—	278.4	286.5	702,553	335,906
Mar 1984	55.30	123.1	281.9	288.0	715,628	342,332
Apr 1984	—	—	286.1	290.2	712,963	327,550
May 1984	—	—	288.3	292.6	710,040	327,937
Jun 1984	56.95	126.2	291.2	295.3	717,009	347,121
Jul 1984	—	—	295.1	296.0	717,121	369,964
Aug 1984	—	—	297.0	300.8	721,905	361,357
Sep 1984	60.64	133.2	299.9	304.1	721,470	359,218
Oct 1984	—	—	303.7	308.7	717,865	363,755
Nov 1984	—	—	307.4	312.8	717,396	369,771
Dec 1984	62.92	138.6	309.4	315.9	701,198	365,234
Jan 1985	—	—	177.1*	166.6*	—	—
Feb 1985	—	—	182.8*	171.3*	—	—
Mar 1985	—	—	183.6*	—	—	—

*The basis for calculation for these indices has been revised to January 1980 = 100.

UNITED STATES

	Producer Price Index[1]		Consumer Price Index[2]	GNP Implicit Price Deflator[3]	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[4]			
	Industrial Commodities (1967=100)	All Commodities (1967=100)	(1967=100)	(1972=100)	Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)	Electric and Electronic Equipment (SIC 36)
1983 Avg.	315.8	303.1	298.4	215.63	12.57	13.43	10.59	8.65
Jan 1984	319.1	308.0	305.2	—	12.67	13.38	10.91	8.88
Feb 1984	320.6	308.9	306.6	—	12.81	13.34	10.90	8.86
Mar 1984	321.9	311.0	307.3	220.58	12.85	13.33	10.95	8.88
Apr 1984	322.5	311.4	308.8	—	12.91	13.30	10.97	8.89
May 1984	323.3	311.7	309.7	—	12.99	13.37	11.02	8.89
Jun 1984	323.9	311.4	310.7	222.40	12.96	13.40	11.03	8.91
Jul 1984	324.0	312.0	311.7	—	13.02	13.36	11.12	8.95
Aug 1984	323.5	310.9	313.0	—	13.10	13.51	11.13	9.00
Sep 1984	322.3	309.5	314.5	224.57	13.20	13.39	11.23	9.08
Oct 1984	323.2	309.4	315.3	—	13.23	13.53	11.32	9.09
Nov 1984	323.8	310.4	315.3	—	13.23	13.76	11.35	9.15
Dec 1984	323.0	309.9	315.5	226.10	13.28	13.66	11.37	9.27
Jan 1985	323.2	309.8	316.1	—	13.25R	13.71R	11.42R	9.28R
Feb 1985	322.5	309.2	317.4	—	13.30P	13.74P	11.42R	9.27R
Mar 1985	322.6	308.7	318.8	229.01	—	—	11.41P	9.34P

P = Preliminary R = Revised since last month

For annual averages prior to 1983, and for notes pertaining to these statistics, see pages 23-26 of Report 190 of June 1984.

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NUEXCO

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NUEXCO

EXECUTIVE SUMMARY
REPORT 201
(All data as of April 30, 1985)

Exchange Value **$14.25, down $0.75**	The **Exchange Value** is **$14.25** per pound U_3O_8, down $0.75 since last month. Five recent natural uranium sales are reported, involving approximately 1.7 million pounds U_3O_8 equivalent. All involved delivery prior to 1986, and four met the conditions for inclusion in the Transaction Value. Two involved natural UF_6.
UF_6 Value **$40.50**	This month Nuexco begins publishing a value for natural UF_6. The **UF_6 Value** is **$40.50** per kilogram U in UF_6.
Supply-Demand Ratio **rose to 2.0:1**	Active spot and near-term **uranium supply** amounts to **2.7 million** pounds U_3O_8 equivalent, down 1.5 million pounds since last month. Active spot and near-term **uranium demand** totals **1.4 million** pounds, down 2.7 million pounds. The spot and near-term **supply-demand ratio** rose to **2.0:1.**
Transaction Value **fell to $14.90**	The **Transaction Value** is **$14.90** per pound U_3O_8, down $0.15 since last month. The calculation includes 20 transactions involving a total of 2.9 million pounds U_3O_8 and equivalent UF_6, and covers a period of 3 months.
Loan Use Charge Rate **unchanged at 5%**	The **Loan Use Charge Rate** is **5 percent** per annum, unchanged.
Conversion Value **rose to $1.50**	The **Conversion Value** is **$1.50** per pound U as UF_6, up $0.50 since last month. Active secondary market supply for conversion services for delivery within three years totals 550 thousand pounds U as UF_6. Active demand totals 290 thousand pounds U as UF_6.
SWU Values: **$95 for DOE-origin for delivery by the end of FY86** **$80 for non-DOE origin calendar year 1985** **$85 for calendar year 1986**	The **SWU Values** for DOE origin at .3 tails and certifiable as excess, are **$95** per SWU for delivery by the end of FY86. SWU Values for other SWUs (non-DOE or non-certifiable) are **$80** per SWU for calendar year 1985 delivery, and **$85** per SWU for calendar year 1986 delivery. One secondary market SWU transaction is reported, involving less than 50 thousand SWUs of DOE origin.
Basic Considerations	The AVLIS technology for uranium enrichment soon may be chosen as DOE's future enrichment method. The process utilizes lasers to separate the uranium isotopes, and could result in lower-cost separative work in the USA.
South Africa	First-quarter production results from Chamber of Mines producers have been released. The closure of two mines in late 1984 contributed to a slightly lower output.

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NUEXCO REPORT 201 FIGURES OF THE MONTH (April 30, 1985)	This Month (Report 201)	Last Month (Report 200)	12 Months Ago (Report 189)
Exchange Value[1]	14.25	15.00	17.75
Transaction Value[1]	14.90	15.05	17.90
UF_6 Value[2]	40.50	—	—
Loan Use Charge Rate[3]	5%	5%	6%
Conversion Value[4]	1.50	1.00	0.80
Near-Term Uranium Supply[5]	2.7	4.3	7.4
Near-Term Uranium Demand[6]	1.4	4.1	3.4
Near-Term Supply-Demand Ratio	2.0	1.0	2.2
Recent Uranium Sales:			
Number of Transactions[7]	5	11	0
Quantity of Material[8]	1.7	2.1	—
Nuexco SWU Values:[9]			
DOE origin, certifiable as excess, 0.3 tails assay; delivery before the end of FY86	95	—	—
Other SWUs (non-DOE or non-certifiable)			
1985 delivery	80	80	80
1986 delivery	85	85	—
USDOE SWU Prices:			
USEC	135.00	135.00	135.00
AFC	153.00[10]	153.00[10]	153.00[10]
Requirements	157.00[10]	157.00[10]	157.00[10]
Market Value of Enriched UF_6[11] [12]:			
2.5 w/o U_{235}	458	471	556
3.0 w/o U_{235}	592	608	716
3.5 w/o U_{235}	728	748	879
4.0 w/o U_{235}	866	890	1,045

---

[1] US $ per pound U_3O_8 equivalent.

[2] US $ per kilogram U as UF_6.

[3] Per annum.

[4] US $ per pound U as UF_6.

[5] Active inquiries to sell, for delivery within 12 months after contract signing (millions of pounds U_3O_8).

[6] Active inquiries to purchase, for delivery within 12 months after contract signing (millions of pounds U_3O_8).

[7] Uranium sales only; does not include loans, conversion, or SWU transactions.

[8] Millions of pounds U_3O_8, equivalent.

[9] US $ per SWU.

[10] Effective 10/1/84.

[11] Calculated using the Nuexco Exchange Value, Conversion Value, and 0.30 percent tails assay. From 10/31/83 through 2/29/84, calculations used the Nuexco SWU Value for DOE origin and FY84 delivery. As of 3/31/84, calculations use the Nuexco SWU Value for DOE origin and FY85 delivery.

[12] US $ per KgU as UF_6, rounded to the nearest $.

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JUNE 1985 **NUMBER 202**

MONTHLY REPORT

ON THE NUCLEAR FUEL MARKET

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MONTHLY REPORT ON THE NUCLEAR FUEL MARKET

June 1985 No. 202

R. WESLEY MILLER, *EDITOR* CLARK M. BEYER, *ASSOCIATE EDITOR*

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To Our Readers

Nuexco would like to announce that **Scott Hickman,** Regional Marketing Manager in our European office, has been granted a two-year leave-of-absence to attend Harvard Business School. Scott left Nuexco at the end of May, and in the fall will pursue a master's degree in Business Administration. We wish him the best of luck in his studies. In the interim, Scott's clients will be handled by our European office.

* * *

Nuexco's US offices will be closed for the Independence Day holiday on Thursday, July 4, 1985.

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NATURAL URANIUM AND SECONDARY MARKET CONVERSION

The **Exchange Value** as of May 31, 1985 is **$15.00** per pound U_3O_8, up $0.75 since last month. **Active supply** of natural uranium (U_3O_8 and UF_6) for spot or near-term delivery totals **2,655,000** pounds equivalent U_3O_8 as concentrates or UF_6, down 65,000 pounds since last month. The corresponding figure for **active demand** is **940,000** pounds, down 455,000 pounds. The spot and near-term **supply-demand ratio** rose to **2.8:1.**

The *Current Market Data* section of this Report lists eight natural uranium sales transactions, involving a total of approximately 3,500,000 pounds U_3O_8 equivalent. Seven of the transactions reported this month involved deliveries before 1986, and six met the criteria for inclusion in the current Transaction Value calculation.

The **UF_6 Value** as of May 31, 1985, is **$42.50** per kilogram U in UF_6, up $2.00 since last month. One of the transactions reported this month involved UF_6.

The **Transaction Value** as of May 31, 1985 is **$14.45** per pound U_3O_8, down $0.45 since last month. The current Transaction Value includes 20 transactions involving a total of 4.6 million pounds U_3O_8 or equivalent UF_6 and covers a period of 3 months. The Transaction Value continues to fall as expected due to the inclusion in the calculation of transactions from the past three months, most of which took place at prices in the $14.00 to $15.00 range.

The **Loan Use Charge Rate** as of May 31, 1985 is unchanged at **5 percent** per annum, as a transaction was concluded at that rate and a lender continued to offer a substantial quantity of material at that rate.

* * *

The substantial rise in this month's Exchange Value is largely attributable to the firming of the market that occurred following the liquidation of a US producer's inventory at prices near $14.00 in the beginning of May. By the following week, few active sellers remained willing to offer prices at that level, and a gap developed between sellers' offers in the $15.00 range and discretionary buyers' interest level below $14.50. Consequently, there was little activity in mid-May. In the last week of the month, several transactions involving smaller lots of material took place, and some buyers expressed a willingness to pay above $14.50. Thus, the market appears to have stabilized temporarily at the $15.00 level.

Current market participants can be divided into four general groups:

Distress sellers. This class of sellers is comprised of utilities and producers that have decided to sell inventory at whatever price is necessary to generate cash. While utilities having canceled or long-delayed plants have dominated this category, a number of producers having chosen to leave the uranium business or liquidate stagnant lots of material also have contributed to this category, as demonstrated in April and May. Distress sellers evidently have led the spot uranium price recently with sales in the range of $14.00-$14.50 per pound U_3O_8 and $40.00-$41.00 per kilogram U in UF_6.

Discretionary sellers. This term applies to low-cost producers, traders, and financially sound utilities that wish to sell uranium but only at what are perceived to be acceptable prices, either relative to the Exchange Value or relative to actual production costs. Traders having excess quantities of uranium have been active in this regard for small quantities of material, while Canadian producers have led this class of seller for larger quantities. Discretionary sellers recently have shown interest in prices approaching $15.00 per pound U_3O_8 and $43.50 per kgU in UF_6.

Discretionary buyers. This term applies to utilities and trading companies that wish to take advantage of bargain prices despite having no immediate need for uranium. In the case of utilities having unfilled requirements in the immediate term, discretionary purchases can be added to inventory and used to defer requirements. In the case of traders, such purchases may be made in the anticipation that the material can be resold subsequently at higher prices. Discretionary buyers' interest level currently approaches $14.75 per pound U_3O_8 and $42.00 per kgU in UF_6.

Firm buyers. This class of buyer includes utilities and producers that must meet actual near-term requirements, as well as companies that have made firm decisions to buy regardless of small spot price fluctuations. A buyer needing immediate deliveries of uranium obviously will pay whatever price is necessary to meet his schedule, and if no distress sellers are in the market at the time his decision is made, the actual price he pays may exceed other prices paid in recent transactions. Current firm buyers may pay as high as $15.50 per pound U_3O_8 or $44.00 per kgU in UF_6 in order to meet requirements. Buyers demanding specific material origin, form or delivery location also may pay a premium above other transaction prices.

* * *

The upward turn in the Exchange Value this month represents only the third reversal in a downward price

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trend that began in August 1978. The first consistent decline in spot prices started at the $43.40 level and reached a low of $17.00 in September 1982. The first reversal occurred in October 1982 and lasted for only 12 months, as prices peaked at $24.00 in September 1983. The downward trend resumed, reversing for a single month in April 1984 before reaching a new low of $14.25 in April 1985.

As expected, the volume of material sold for spot and near-term deliveries tended to peak when prices were approaching or reaching low points. Thus, in the periods of mid-1982, late 1983 and late 1984 to early 1985, considerable activity took place. As uranium prices declined, discretionary buyers became increasingly interested in the bargain prices offered by distress sellers which were forcing material onto the market. In the past several months, discretionary buyers have been faced with a conflicting option:

1. Purchasing material immediately to take advantage of the inventory clearances could result in a missed opportunity to buy at even lower prices one or two months later.
2. Conversely, deferring immediate purchases in the hopes that the downward price trend will continue runs the risk that prices may reverse and current prices will be unattainable later.

To date, however, upward price movement has not been sustainable primarily due to two effects of such upward movement. First, each rise stimulated new liquidations of inventory. Second, willing buyers are necessary in order to sustain the higher price levels, yet such buyers have tended to withdraw as soon as any price-firming is detected. The current upturn could trigger a repeat of these phenomena. However, the industry is recognizing that distress sellers enter the market one at a time as their selling mode is triggered by some external event, and withdraw from the market singly as their material is absorbed. An industry perception that distress selling is approaching an end could stimulate a surge of activity as buyers compete for the final lots of inventory at below-market prices. In addition, sustainable higher prices require not only an end to inventory liquidation, but also a constant buyer presence. To the extent that many buyers have filled a portion of their longer-term needs through discretionary buying practices in the past year, they are unlikely to provide a continuing demand which will sustain higher prices in the near term. Any such demand will have to come from other buyers with definite intermediate or longer-term needs. These buyers are likely to contract with producers instead of inventory liquidators, and prices driven by production costs can be anticipated.

A transition to this type of market environment is inevitable, but the change is apt to be more gradual and subtle than abrupt and easily defined. As more inventory is absorbed by the market, the timing of market activities becomes more important for buyers and sellers alike.

* * *

The **UF_6 Value** rose to **$42.50** in conjunction with the rise of the Exchange Value, primarily due to the minimal amount of natural uranium available in the present market. A high availability of UF_6 would result in lower prices for utilities purchasing UF_6 rather than obtaining concentrates and secondary market conversion services. In the former case, the UF_6 Value would be slightly less than the sum of the Exchange Value and the Conversion Value. However, at present the two options for acquiring UF_6 are equally cost-effective.

* * *

The **Conversion Value** is **$1.50** per pound U in UF_6, unchanged since last month. One secondary market conversion transaction is reported. Active supply of secondary market conversion services for delivery within three years totals 1.6 million pounds U as UF_6. Active secondary market demand for conversion amounts to 965,000 pounds U in UF_6.

The secondary market for conversion services remains marginally active, with transaction prices stabilized in the $1.45 to $1.75 range. Without a large supply of UF_6 available at prices beneath the sum of the Exchange Value and Conversion Value, some discretionary buyers are electing to wait for low-priced U_3O_8 to appear, as in the beginning of May, and purchasing conversion services for that material immediately.

ENRICHED URANIUM AND SWUS

The Nuexco **SWU Values** as of May 31, 1985 are:

1. For **DOE origin,** a tails assay of 0.30 weight-percent U_{235}, for delivery by the end of FY86, and certifiable as excess, $90 per SWU, down $5.
2. For **other SWUs** (includes DOE origin SWUs not certifiable as excess and non-DOE origin SWUs):
   a. For delivery in calendar year 1985, $80 per SWU, unchanged;
   b. For delivery in calendar year 1986, $85 per SWU, unchanged.

Two secondary market SWU transactions are reported, involving 500 thousand SWUs of DOE and Eurodif origin.

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Relatively little activity took place in the secondary market for either certifiable or non-certifiable SWUs. Aggressive sellers of DOE-certifiable SWUs continue to lower their prices to complete transactions. While no real market for FY85 deliveries exists, there are some opportunities for FY86 DOE SWUs. However, the buyers having actual requirements in FY86 that can be filled on the secondary market are at present evaluating purchasing strategies and still are not compelled to act immediately.

The lack of activity in the market for other SWUs continued, and prices remained at the levels established last month. As in the DOE-certifiable market, FY86 buyers of other SWUs are examining the various options available to them, including the Eurodif responses to DOE's incentive-pricing campaign.

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CURRENT MARKET DATA

May 31, 1985	Market Values	Active Supply[1] (thousands)	Active Demand[1] (thousands)
EXCHANGE VALUE	**\$15.00**/lb. U_3O_8	2,655	940
UF_6 VALUE	**\$42.50**/kgU		
CONVERSION VALUE	**\$1.50**/lb. U in UF_6	1,600	965
SWU VALUES			
DOE origin, certifiable as excess, 0.3 tails assay delivery by the end of FY86	**\$90**/SWU		
Other SWUs (non-DOE or non-certifiable)			
calendar year 1985 delivery	**\$80**/SWU		
calendar year 1986 delivery	**\$85**/SWU		
LOAN USE CHARGE RATE	**5%**/annum	0	300

TRANSACTION VALUE

\$/lb. U_3O_8	Millions of Pounds	Number of Transactions	Number of Months
14.45	4.6	20	3

[1] Supply and demand tables in the *Current Market Data* section of this Report detail the numbers for each category.

DEFINITIONS

1. The **Exchange Value** is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the date indicated.
2. The **UF_6 Value** is Nuexco's judgment of the price at which spot and near-term transactions for significant quantities of natural uranium hexafluoride could be concluded as of the date indicated.
3. The **Conversion Value** is Nuexco's judgment of the price at which spot and near-term transactions for significant quantities of conversion services could be concluded in the secondary market as of the date indicated.
4. The **SWU Values** represent Nuexco's judgment of the price at which transactions for the sale of significant quantities of SWUs of stated origin for delivery in the specified time period could be concluded as of the date indicated.
5. The **Loan Use Charge Rate** is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the date indicated.
6. The **Transaction Value** is a weighted average price of recent natural uranium sales transactions. The calculation is based on prices paid in:
   a. Transactions closed within the previous three-month period for which delivery is scheduled within one year of the transaction date;
   b. At least ten transactions;
   c. Transactions involving a sum total of at least 2 million pounds U_3O_8 equivalent.

   The sample time is extended as necessary to include these minima. Other currencies are converted to US dollars using conversion rates in effect on or near the transaction date.

DERIVATIONS AND COMMENTS

1. All Market Values are based on:
   a. Data from recently completed transactions.
   b. Data from pending transactions.
   c. Firm bids to buy or borrow, and firm offers to sell or lend.
   d. Prices purchasers or rates borrowers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy or borrow, and prices sellers or rates lenders have expressed a willingness to offer, but for which Nuexco is not aware of firm offers to sell or lend.
2. Prices associated with deliveries under old or renegotiated contracts or other than arm's-length transactions are not considered in the determination of these Market Values.
3. In the determination of the Conversion Value, Nuexco does not consider transportation charges other than those customarily provided by primary suppliers of conversion services.
4. The prices of conversion services or SWUs delivered under long-term contracts with primary suppliers are not considered in the determination of either the Conversion Value or SWU Value.
5. For the DOE SWU Values, Nuexco converts SWU prices at varying tails and product assays to equivalent SWU prices at a tails assay of 0.30 weight-percent U_{235} and a product assay of 3.0 weight-percent U_{235}, assuming feed costs corresponding to the Nuexco Exchange and Conversion Values determined as of the same date.
6. In calculating the Transaction Value, Nuexco does not account for the price of uranium delivered in connection with contracts which call for "market price" mechanisms. This exclusion applies particularly to contracts in which delivery prices are expressed as a function of future Exchange Values or any other indeterminant variable. Also excluded from the calculation are any other transactions in which the delivery price is defined in such a way that it cannot currently be determined.

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CURRENT MARKET DATA

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

	per lb. U_3O_8 in Concentrates			per kg. U in Concentrates		
Country (currency)	**This Month (May 31, 1985)**	**Last Month (Apr. 30, 1985)**	**12 Months Ago (May 31, 1984)**	**This Month (May 31, 1985)**	**Last Month (Apr. 30, 1985)**	**12 Months Ago (May 31, 1984)**
Australia (dollar)	22.56	21.72	19.74	58.64	56.47	51.33
Belgium (comm. franc)	931.68	891.18	986.66	2,422	2,317	2,565
Canada (dollar)	20.64	19.49	22.97	53.67	50.66	59.72
Finland (markka)	95.97	92.47	102.84	249.50	240.41	267.36
France (franc)	140.98	135.46	148.91	366.51	352.16	387.13
FRG (mark)	46.30	44.36	48.51	120.36	115.34	126.12
Italy (lira)	29,492	28,274	29,963	76,674	73,506	77,897
Japan (yen)	3,773	3,598	4,107	9,810	9,355	10,677
Netherlands (guilder)	52.16	50.09	54.72	135.59	130.22	142.25
South Africa (rand)	29.97	27.75	22.73	77.92	72.15	59.09
Spain (peseta)	2,612	2,492	2,726	6,792	6,479	7,087
Sweden (krona)	133.45	128.49	143.49	346.95	334.06	373.05
Switzerland (franc)	39.00	37.23	40.12	101.40	96.78	104.31
UK (pound)	11.77	11.58	12.81	30.61	30.10	33.29
US (dollar)	15.00	14.25	17.75	39.00	37.05	46.15

TRANSACTION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

	per lb. U_3O_8 in Concentrates			per kg. U in Concentrates		
Country (currency)	**This Month (May 31, 1985)**	**Last Month (Apr. 30, 1985)**	**12 Months Ago (May 31, 1984)**	**This Month (May 31, 1985)**	**Last Month (Apr 30, 1985)**	**12 Months Ago (May 31, 1984)**
Australia (dollar)	21.73	22.71	18.91	56.49	59.05	49.16
Belgium (comm. franc)	897.52	931.83	944.97	2,333	2,423	2,457
Canada (dollar)	19.89	20.37	22.00	51.70	52.97	57.20
Finland (markka)	92.45	96.69	98.49	240.35	251.37	256.06
France (franc)	135.81	141.64	142.62	353.07	368.22	370.77
FRG (mark)	44.60	46.39	46.46	115.95	120.60	120.79
Italy (lira)	28,411	29,563	28,697	73,863	76,858	74,605
Japan (yen)	3,635	3,763	3,933	9,450	9,782	10,226
Netherlands (guilder)	50.24	52.37	52.40	130.62	136.16	136.24
South Africa (rand)	28.87	29.02	21.77	75.06	75.44	56.59
Spain (peseta)	2,516	2,606	2,611	6,543	6,775	6,788
Sweden (krona)	128.56	134.36	137.43	334.22	349.29	357.29
Switzerland (franc)	37.57	38.92	38.43	97.68	101.19	99.90
UK (pound)	11.34	12.10	12.27	29.49	31.47	31.89
US (dollar)	14.45	14.90	17.00	37.57	38.74	44.20

[1] Calculated using currency exchange rates published in the *Wall Street Journal* on May 31, 1985.

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CURRENT MARKET DATA

CONVERSION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

	per lb. U as UF_6			per kg. U as UF_6		
Country (currency)	**This Month (May 31, 1985)**	**Last Month (Apr. 30, 1985)**	**12 Months Ago (May 31, 1984)**	**This Month (May 31, 1985)**	**Last Month (Apr. 30, 1985)**	**12 Months Ago (May 31, 1984)**
Australia (dollar)	2.26	2.29	0.89	4.97	5.04	1.96
Belgium (comm. franc)	93.17	93.81	44.47	205.40	206.81	98.04
Canada (dollar)	2.06	2.05	1.04	4.55	4.52	2.28
Finland (markka)	9.60	9.73	4.64	21.16	21.46	10.22
France (franc)	14.10	14.26	6.71	31.08	31.43	14.80
FRG (mark)	4.63	4.67	2.19	10.21	10.30	4.82
Italy (lira)	2,949	2,976	1,350	6,502	6,561	2,977
Japan (yen)	377.36	378.79	185.10	831.93	835.08	408.07
Netherlands (guilder)	5.22	5.27	2.47	11.50	11.62	5.44
South Africa (rand)	3.00	2.92	1.02	6.61	6.44	2.26
Spain (peseta)	261.28	262.33	122.87	576.02	578.34	270.88
Sweden (krona)	13.35	13.53	6.47	29.42	29.82	14.26
Switzerland (franc)	3.90	3.92	1.81	8.60	8.64	3.99
UK (pound)	1.18	1.22	0.58	2.60	2.69	1.27
US (dollar)	1.50	1.50	0.80	3.31	3.31	1.76

SWU VALUES AND UF_6 VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	**DOE SWU Delivery by the End of FY86 (May 31, 1985)**	**Non-DOE SWU 1985 Delivery (May 31, 1985)**	**Non-DOE SWU 1986 Delivery (May 31, 1985)**	**UF_6 per kg. U in UF_6 This Month (May 31, 1985)**	**UF_6 per kg. U in UF_6 Last Month (April 30, 1985)**
Australia (dollar)	135.34	120.30	127.82	63.91	61.74
Belgium (comm. franc)	5,590	4,968	5,279	2,639	2,533
Canada (dollar)	123.86	110.10	116.98	58.49	55.38
Finland (markka)	575.82	511.84	543.83	271.91	262.82
France (franc)	845.86	751.88	798.87	399.44	384.98
FRG (mark)	277.78	246.91	262.35	131.17	126.09
Italy (lira)	176,956	157,294	167,125	83,562	80,357
Japan (yen)	22,641	20,125	21,383	10,691	10,227
Netherlands (guilder)	312.93	278.16	295.55	147.77	142.36
South Africa (rand)	179.82	159.84	169.83	84.92	78.87
Spain (peseta)	15,676	13,934	14,805	7,402	7,083
Sweden (krona)	800.71	711.74	756.23	378.11	365.19
Switzerland (franc)	234.01	208.01	221.01	110.50	105.80
UK (pound)	70.65	62.80	66.72	33.36	32.90
US (dollar)	90.00	80.00	85.00	42.50	40.50

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[1] Calculated using currency exchange rates published in the *Wall Street Journal* on May 31, 1985.

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RECENT TRANSACTIONS[1]

Uranium Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U_3O_8 equivalent)	Approximate Price as Percent of Current E.V.	Seller	Buyer	Remarks
3454	1985	50-100	94	US Producer	US Utility	
3452	1985	50-100	96	US Producer	US Utility	
3438	1985	1,001-1,500	97	US Utility	Far East Utility	
3425	1985	301-600	indeterminate	US Producer	US Producer	Market-related price.
3424	1985	101-300	97	R[2]	European Utility	UF_6.
3419	1985	301-600	96	US Producer	European Utility	
3418	1985	101-300	95	Trader	US Utility	
3416	1987-1988	101-300	144	US Producer	US Producer	

[1] Transactions listed are not limited to those in which Nuexco was involved, but also include others of which Nuexco is aware.

[2] The notation *R* means that Nuexco either does not know, or that Nuexco has restricted that information to protect client confidentiality.

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CURRENT MARKET DATA

RECENT TRANSACTIONS[1] *(continued)*

Loan Transactions

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U_3O_8 equivalent)	Approximate Price as Percent of Current L.U.C.R.	Lender	Borrower
3451	1985	50-100	100	European Entity	Trader

Secondary Market Conversion Services

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U equivalent)	Approximate Price as Percent of Current C.V.	Seller	Buyer	Remarks
3426	1987-1988	301-600	indeterminate	Fabricator	European Utility	Price escalated from contract signing.

Enrichment Services
Secondary Market Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity[2] (thousands of SWUs)	Approximate Price[3] as Percent of Current SWU Value[4]	Seller Group	Buyer Group	SWU Origin	Remarks
3453	1986	301-600	91	European Entity	US Utility	Eurodif	
3410	1985	50-100	106	US Utility	European Utility	DOE	

---

[1] Transactions listed are not limited to those in which Nuexco was involved, but also include others of which Nuexco is aware.

[2] If tails assay is unknown or unspecified, Nuexco's calculation of SWU quantity assumes 0.30 w/o tails assay.

[3] Price is not normalized to 0.30% tails assay.

[4] Refers to SWU Value that corresponds to SWUs included in transaction. When prices and SWU values are expressed as discounts (e.g., X dollars less than DOE's USEC base price at time of delivery), the percentage refers to the ratio of the *discounts*, not the ratio of the prices.

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URANIUM SUPPLY
(May 31, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Spot or Near-term[2]	Delivery Period[1] (Thousands of Pounds U_3O_8) Intermediate or Long-term	Remarks
Available for Sale:			
ACTIVE			
1575	500	500 per year	
1860	400	1,500 per year	
2134*	50	220 per year	1985-87
2392	35	—	UF_6
2538*	100	—	
2538B*	150	—	
2594	20	20 per year	1985-90
2673*	1,200	—	UF_6
2705A	200	—	UF_6
2263	—	500 per year	1987-90
2625	—	250 per year	1987-89
2680	—	250 per year	1986-92
TOTAL:	2,655		
INACTIVE			
2191	125	—	UF_6
2335	275	—	
2336	250	250 per year	1985-94
2389*	300	—	
2553	300	—	
2654	250	250 per year	UF_6
2297	—	200 per year	1986-89
2670	—	525	1987
TOTAL:	1,500		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2510, 2675.

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CURRENT MARKET DATA

URANIUM DEMAND
(May 31, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Spot or Near-term[2]	Intermediate or Long-term	Remarks
Inquiries to Purchase: ACTIVE			
2548	290	—	
2590	75	—	U_3O_8 or UF_6
2636	100	—	
2699*	100	—	U_3O_8 or UF_6
2716*	150	—	UF_6
2748*	25	75	
2751*	200	—	
2217	—	1,000 per year	1989-95
2507	—	600	1987-89
2681	—	1,000 per year	1987-88
TOTAL:	940		
INACTIVE			
2576	20	—	UF_6
2695	1,250	—	UF_6
2414	—	365	1987-88
2457B	—	650	1987
2586	—	300	1987
2643	—	150 per year	1987 on
2694	—	625	1987; UF_6
TOTAL:	1,270		

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*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2674.

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LOAN SUPPLY AND DEMAND
(May 31, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Within 1 Year	Beyond 1 Year	Remarks
Available for Loan: INACTIVE			
1938	2,000	—	UF_6
2036*	500	—	
2469A	800	—	
2483	550	—	
2667	800	—	
TOTAL:	4,650		
Inquiries to Borrow: ACTIVE			
2606*	300	—	
TOTAL:	300		

*New or revised since last month.

[1] Measured from the date of this Report.

Projects removed since last month: 2139.

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CURRENT MARKET DATA

CONVERSION SUPPLY AND DEMAND
(May 31, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U as UF₆)		Remarks
	Within 3 Years	Beyond 3 Years	
Available for Sale:			
ACTIVE			
1936*	440	550	1986-89
2511*	300	300	1986-90
2677*	500	—	
2725*	360	—	
TOTAL:	1,600		
INACTIVE			
2438	500	250 per year	1986-87
TOTAL:	500		
Inquiries to Purchase:			
ACTIVE			
2419A	55	—	
2587	35	—	
2596*	600	—	
2617*	275	420	1986-91
TOTAL:	965		
INACTIVE			
2529	225	—	
2724	—	375	1989-93
TOTAL:	225		

*New or revised since last month.

[1] Measured from the date of this Report.

Projects removed since last month: 2051, 2602, 2644.

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SWU SUPPLY
(May 31, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of SWUs) Spot or Near-term[2]	Intermediate or Long-term	Remarks
Available for Sale:			
ACTIVE			
2607*	350	—	
2624	100	—	
2633B	330	—	
2705	40	—	
2359	—	200	
2410A*	—	350	
2571	—	55	1987
2684	—	35	
TOTAL:	820		
INACTIVE			
2164	20	—	
2378	—	120	1988
2652	—	25	1986
TOTAL:	20		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes SWUs deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2517.

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SWU DEMAND
(May 31, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of SWUs) Spot or Near-term[2]	Delivery Period[1] (Thousands of SWUs) Intermediate or Long-term	Remarks
Inquiries to Purchase:			
ACTIVE			
2400	—	150	1987-90
2519	—	30 per year	1987 on
2597*	—	30	
2658	—	5	1986
2706*	—	30	
2726*	—	5	
2713	180	—	
TOTAL:	180		
INACTIVE			
2543	25	25	1986
2500	—	170	1988
2512	—	15 per year	1987 on
2595	—	50	1986
2693	—	100 per year	1989-90
TOTAL:	25		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes SWUs deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2585, 2653, 2655.

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FOCUS

THE NUCLEAR FUEL MARKET IN THE FEDERAL REPUBLIC OF GERMANY

Introduction

The nuclear fuel market in the Federal Republic of Germany (FRG) is decentralized and highly competitive compared to those of other countries outside the USA. Most other countries have few companies (often state-owned) participating in the market, and sometimes only one. The market in Germany, however, is diversified internally; headquarters for several internationally active nuclear fuel businesses are located in the FRG. Seventeen nuclear power units are in commercial operation in the FRG and six are under construction; more than twenty-five different companies own direct shares in those units. While little uranium is produced domestically, at least six independent non-utility companies take principal positions in the nuclear fuel market, buying or selling uranium for their own accounts.

Nuclear Fuel Demand

As in the USA and many other countries, far fewer units have been built in the FRG than were originally planned in the 1960s and 1970s, and no new units are likely to be ordered in the foreseeable future (Figure 1 and Table 1). As elsewhere, reductions in planned capacity resulted from political delays, cost escalations, and declining electricity demand.

Recently the utilities and the primary German vendor, Kraftwerk Union (KWU), have made noteworthy progress toward bringing the backlog of ordered units into operation. In the past eighteen months, six units have begun operation, adding some 6,000 MWe of capacity to the national grid. Five of those units were built by KWU and one, the THTR at Hamm-Uentrop, by a consortium led by Brown Boveri (BBC). The utilities have profited from KWU's construction experience and the generally favorable political environment at the federal and state levels. The Christian Democrats (CDU), who currently have a majority in the federal parliament and in six of the eleven state governments, have strongly supported the utilities (Table 2). The opposition Social Democrats (SPD) have generally assented to nuclear power development, except in regions where coal interests or Green Party activists are particularly influential, as in the Saarland and in Hesse.

Figure 2 diagrams the ownership of all commercial units except for the Kalkar fast-breeder reactor, which is a joint European project. Figure 3 shows the service areas of the nine major regional utilities. HEW, NWK and PREAG are the principal utilities in the northern and eastern states of Schleswig-Holstein, Lower Saxony and Hesse; VEW in western Lower Saxony and northern North-Rhine Westphalia; RWE in North-Rhine Westphalia and Rhineland Palatinate; Badenwerk, EVS, and Neckarwerke in Baden-Wuerttemberg; and Bayernwerk and Isar-Amperwerke in Bavaria. RWE is the country's largest utility, followed by PREAG, a wholesale utility and a 69.4-percent owner of NWK.

Most FRG nuclear units are owned by utility consortia, with each consortium led by one or more of the principal utilities. A subsidiary or consortium formed solely to build and operate a nuclear plant can be recognized by the German word *Kernkraftwerk* (nuclear power plant). For example, the consortium owning the Obrigheim unit is Kernkraftwerk Obrigheim GmbH (KWO), and that operating the two-unit Neckar plant is Gemeinschaftskernkraftwerk Neckar GmbH (GKN).[1]

Due to long-term contracting and the accumulation of inventories during the years that plant constructions were delayed, few of the German utilities have unfilled uranium requirements for the intermediate term. One utility has an inventory valued internally at over 1 billion Deutschmarks (330 million dollars). Nuexco estimates that the total national inventory exceeds 35 million pounds U_3O_8 equivalent. Much of the material is stored domestically. Over 7 million pounds U_3O_8 equivalent are owned by the German government and constitute a strategic reserve; the material was acquired from the USA during the 1970s to offset US military expenditures in the FRG. Commercial reprocessing, which is pursued by several of the utilities, also has reduced unfilled requirements.

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[1] The abbreviation *GmbH* (Gesellschaft mit beschraenkter Hastung) indicates that a company's capital is held by two or more shareholders, but is not publicly traded, while the abbreviation *AG* (Aktiengesellschaft) indicates that shares in the company are bought and sold on the public stock exchange.

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Table 1

NUCLEAR POWER UNITS IN THE FEDERAL REPUBLIC OF GERMANY

Lead Utility and Fuel Buyer	Unit	MWe	Type	COD[1]	Percent Complete
BW/EVS	Philippsburg 1	864	BWR	2/80	100
	Philippsburg 2	1268	PWR	5/85	100
BAG	Grafenrheinfeld	1235	PWR	6/82	100
	Isar 1	870	BWR	3/79	100
	Isar 2*	1285	PWR	4/89	45
GKN	GKN 1	795	PWR	12/76	100
	GKN 2*	1230	PWR	6/89	25
HEW	Brunsbuettel	771	BWR	2/77	100
	Kruemmel	1260	BWR	3/84	100
KWO	Obrigheim 1	328	PWR	3/69	100
NWK	Stade	630	PWR	5/72	100
	Unterweser	1230	PWR	10/79	100
	Brokdorf*	1290	PWR	6/87	70
PREAG	Wuergassen	640	BWR	3/72	100
	Grohnde	1290	PWR	2/85	100
RWE	Biblis A	1146	PWR	3/75	100
	Biblis B	1240	PWR	1/77	100
	Gundremmingen B	1244	BWR	7/84	100
	Gundremmingen C	1244	BWR	6/85	100
	Kaerlich*	1227	PWR	8/86	90
SBK	Kalkar*	295	LMFBR	4/87	85
VEW	THTR 300	296	HTR	7/85	100
	Emsland*	1242	PWR	10/88	40
		22,910			

BW = Badenwerk AG
BAG = Bayernwerk AG
EVS = Energieversorgung Schwaben AG
GKN = Gemeinschaftskernkraftwerk Neckar GmbH
HEW = Hamburgische Elektrizitaetswerke AG
*Unit under construction.
[1] Commercial Operating Date.

KWO = Kernkraftwerk Obrigheim GmbH
NWK = Nordwestdeutsche Kraftwerk AG
PREAG = Preussische Elektrizitaets AG
RWE = Rheinisch-Westfaelisches Elektrizitaetswerk AG
SBK = Schnell-Breuter Kernkraftwerksgesellschaft mbH
VEW = Vereinigte Elektrizitaetswerke Westfalen AG

Table 2

POLITICAL SUBDIVISIONS IN THE FRG *(See Figure 1)*

State	Number of Nuclear Units	Governing Political Party
1. Schleswig-Holstein	3	CDU (Christian Democratic Union)
2. Hamburg	0	SPD (Social Democratic Party)
3. Bremen	0	SPD
4. Lower Saxony	4	CDU
5. Berlin	0	CDU/FDP (Free Democratic Party)
6. North-Rhine Westphalia	3	SPD
7. Hesse	2	SPD
8. Rhineland Palatinate	1	CDU
9. Saarland	0	SPD
10. Baden-Wuerttemberg	5	CDU
11. Bavaria	5	CSU (Christian Social Union)
Total FRG	23	CDU

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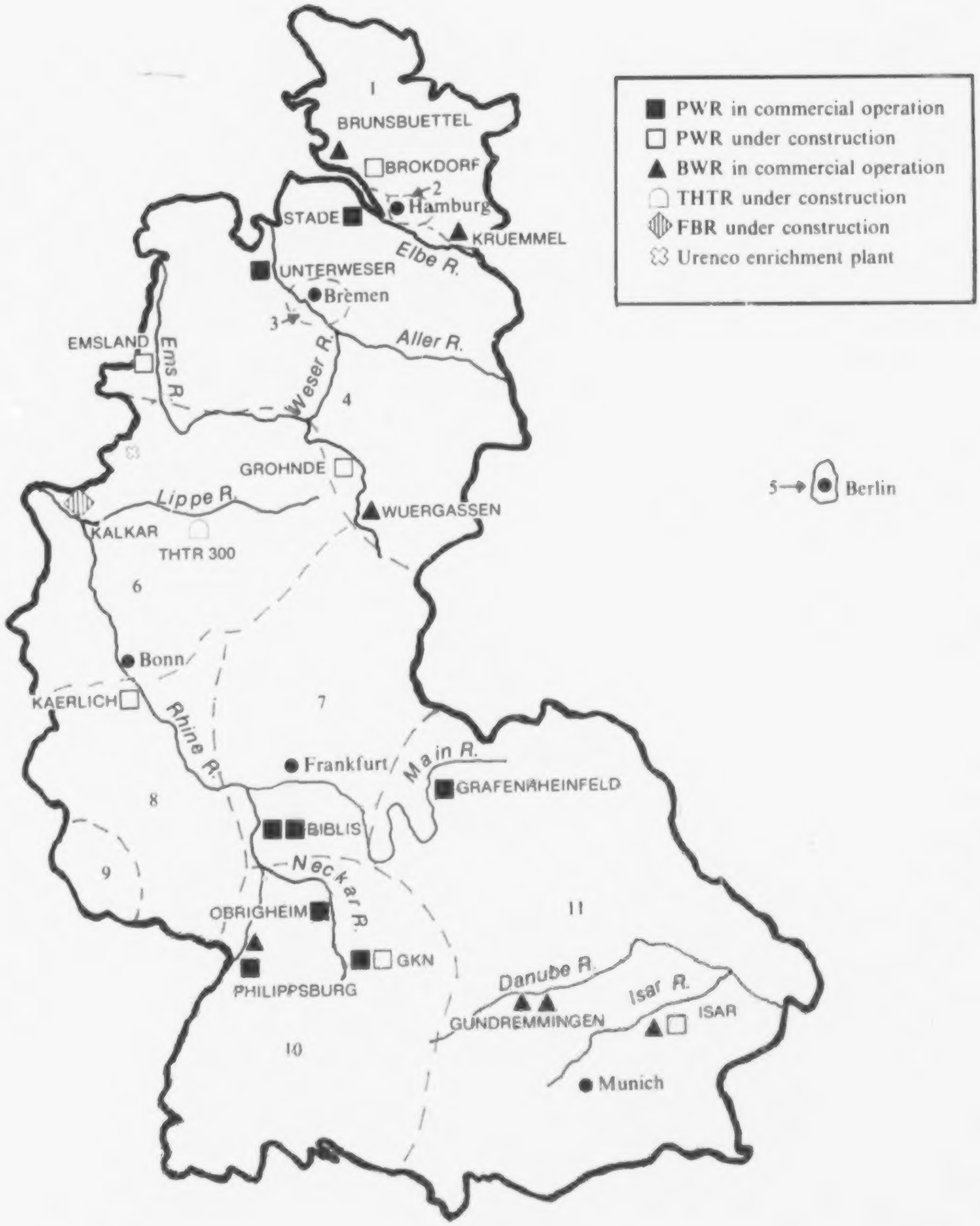
■ PWR in commercial operation
□ PWR under construction
▲ BWR in commercial operation
THTR under construction
FBR under construction
Urenco enrichment plant
1
BRUNSBUETTEL
BROKDORF
2
Hamburg
STADE
KRUEMMEL
Elbe R.
UNTERWESER
Bremen
3
EMSLAND
Ems R.
Weser R.
Aller R.
4
GROHNDE
Lippe R.
WUERGASSEN
KALKAR
THTR 300
5
Berlin
6
Bonn
KAERLICH
Rhine R.
7
Frankfurt
Main R.
GRAFENRHEINFELD
8
BIBLIS
Neckar R.
9
OBRIGHEIM
11
PHILIPPSBURG
GKN
Danube R.
Isar R.
GUNDREMMINGEN
ISAR
10
Munich

Figure 1

NUCLEAR POWER UNITS IN THE FRG

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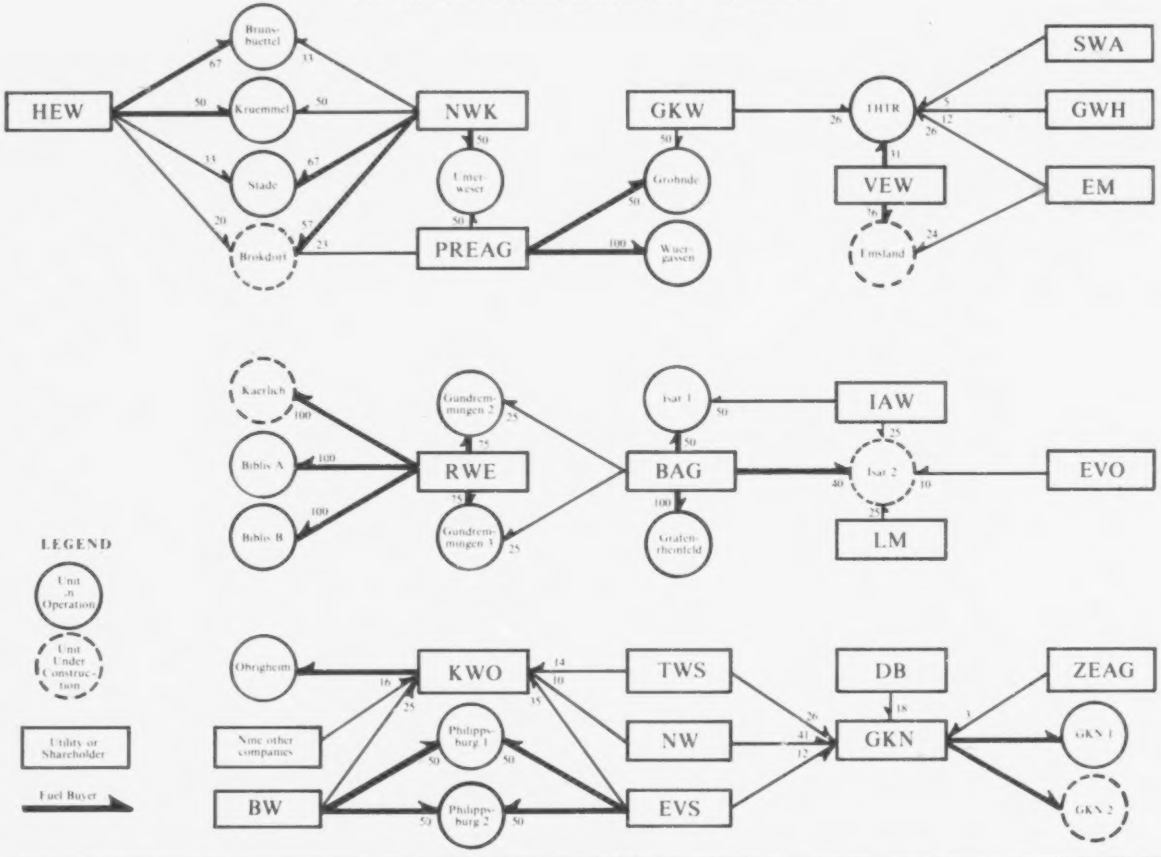
Figure 2

NUCLEAR POWER PLANT OWNERSHIP IN THE FEDERAL REPUBLIC OF GERMANY


HEW
Brunsbuettel
Kruemmel
Stade
Brokdorf
67
50
33
20
33
50
67
57
23
NWK
50
Unterweser
50
PREAG
Grohnde
50
Wuergassen
100
GKW
50
THTR
26
SWA
5
GWH
12
EM
26
VEW
31
76
Emsland
24
Kaerlich
100
Biblis A
100
Biblis B
100
RWE
Gundremmingen 2
75
25
Gundremmingen 3
75
25
BAG
Isar 1
50
50
Grafenrheinfeld
100
IAW
25
Isar 2
40
EVO
10
LM
25
LEGEND
Unit in Operation
Unit Under Construction
Utility or Shareholder
Fuel Buyer
Obrigheim
KWO
16
25
Nine other companies
TWS
14
10
35
Philippsburg 1
50
50
BW
Philippsburg 2
50
50
EVS
NW
DB
18
GKN
26
41
12
ZEAG
3
GKN 1
GKN 2

BAG	Bayernwerk AG
BW	Badenwerk AG
DB	Deutsche Bundesbahn
EM	Elektromark AG
EVO	Energieversorgung Ostbayern AG
EVS	Energieversorgung Schwaben AG
GKN	Gemeinschaftskernkraftwerk Neckar GmbH
GKW	Gemeinschaftskraftwerk Weser GmbH
GWH	Gemeinschaftswerk Hattingen GmbH
HEW	Hamburgische Elektricitaetswerke AG
IAW	Isar-Amperwerk AG
KWO	Kernkraftwerk Obrigheim GmbH
LM	Landeshauptstadt Muenchen
NW	Neckarwerke Elektrizitaetsversorgung AG
NWK	Nordwestdeutsche Kraftwerke AG
PREAG	Preussische Elektrizitaets AG
RWE	Rheinisch-Westfaelisches Elektrizitaetswerk AG
SWA	Stadtwerke Aachen AG
TWS	Technischewerke der Stadt Stuttgart AG
VEW	Vereinigte Elektrizitaetswerke Westfalen AG
ZEAG	Zementwerk Lauffen-Elektrizitaetswerk Heilbronn AG

The ownership figures in Figure 2 for GKN represent the average participation of each shareholder in the two-unit plant; the shareholders have slightly different investments in the individual units GKN 1 and GKN 2.

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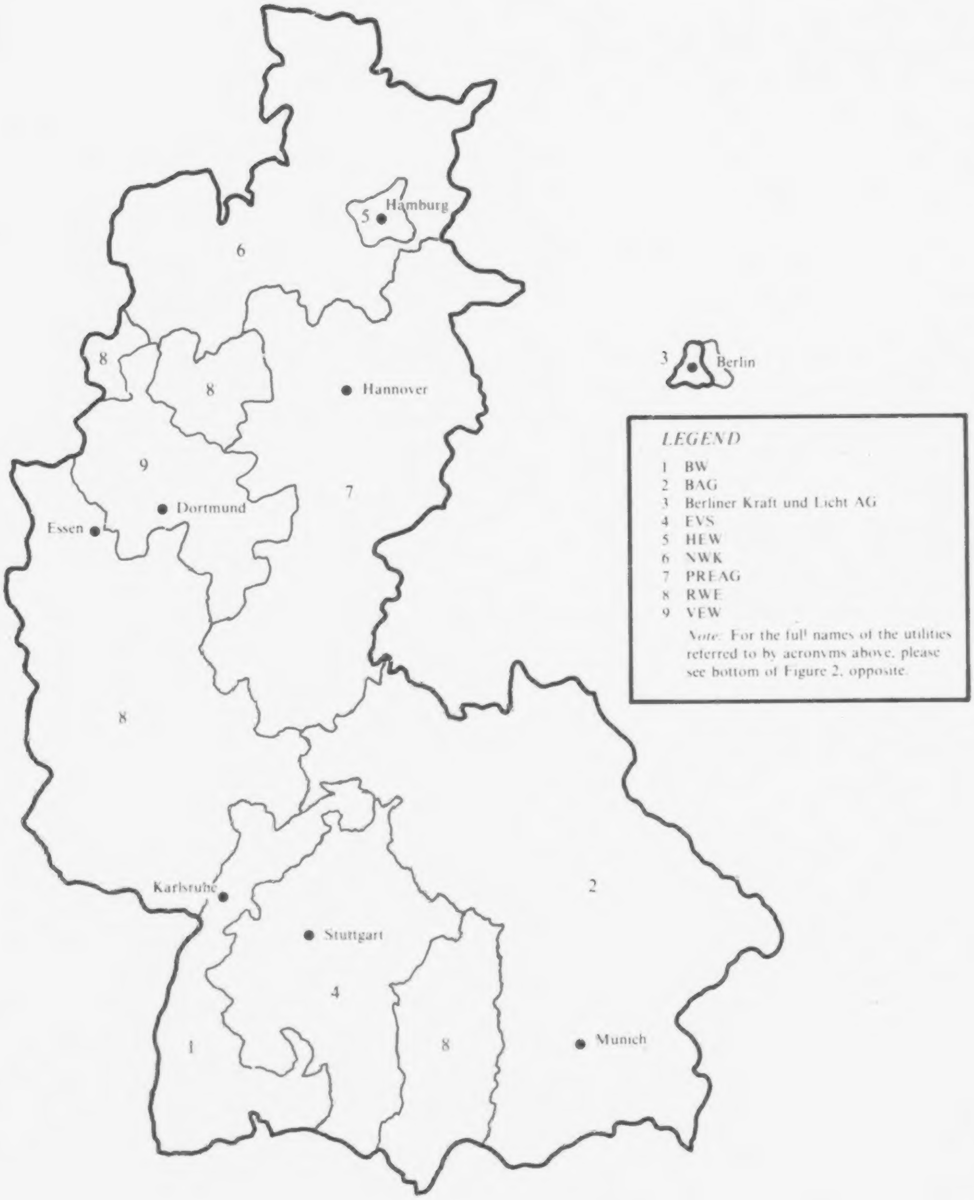
5
Hamburg
6
3
Berlin
8
8
Hannover
9
Dortmund
Essen
7
8
Karlsruhe
2
Stuttgart
4
1
8
Munich
LEGEND
1 BW
2 BAG
3 Berliner Kraft und Licht AG
4 EVS
5 HEW
6 NWK
7 PREAG
8 RWE
9 VEW

Note: For the full names of the utilities referred to by acronyms above, please see bottom of Figure 2, opposite.

Figure 3

SERVICE TERRITORIES OF PRINCIPAL GERMAN UTILITIES

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FOCUS

Utility Participation in Uranium Supply

Figure 4 illustrates the ownership relationships connecting certain German utilities and the four German companies that own shares in major uranium production operations. Badenwerk and EVS jointly own 25 percent of Saarberg Interplan Uran GmbH (SIPU), a uranium exploration and supply company holding 3.75 percent of Energy Resources of Australia (ERA), the owner of the Ranger mine. Saarbergwerke AG, a Saarland coal company, owns 75 percent of SIPU. SIPU supplies over half the natural uranium requirement for the two-unit Philippsburg plant (owned by Badenwerk and EVS) with deliveries from Ranger.

RWE owns 6.25 percent of Ranger through its wholly-owned fuel subsidiary RBW (Rheinisch-Braunkohlenwerke AG, Germany's major coal producer). RBW also owns 75 percent of UEM (Uranerz Exploration and Mining Co.), which is a one-third partner in the Key Lake project, and also owns 50 percent of UEB (Uranerzbergbau GmbH). Thus, Ranger and Key Lake are RWE's principal long-term sources of uranium. In addition to these investments, RWE indirectly owns 10.5 percent of Steag AG, an energy group, which operates a subsidiary, Steag Kernenergie GmbH, that is an active trader in the spot uranium market and a participant in other fuel-cycle markets. Steag owns one-third of Urangesellschaft mbH (UG), an owner in ERA, Rossing (Namibia), and Somair (Niger). RWE also holds 45 percent of Nukem GmbH, which is active in the uranium spot market and in fuel fabrication, and which in turn owns 40 percent of Uranit GmbH, the German participant in the Urenco enrichment group.

Besides Steag's one-third share in UG, Metallgesellschaft AG, Germany's largest mining company, and Veba AG, one of the country's leading electrical groups, each own one-third of UG. Veba also owns 10.5 percent of Steag, so its effective interest in UG is slightly greater than one-third. The Veba group owns 86.6 percent of PREAG. Both PREAG and NWK have long-term contracts with UG for the supply of uranium and conversion to cover a portion of requirements. Three of UG's mining investments are now producing uranium commercially—Ranger, Rossing and Somair—and it has recently acquired facilities for U_3O_8 recovery from phosphoric acid. The facility, formerly operated by the Westinghouse uranium production subsidiary, had been shut down in mid-1981, but could produce U_3O_8 in the future.

PREAG also owns 40 percent of Uranit, the centrifuge company, and like RWE will purchase most of its long-term enrichment services from Urenco. It now appears that all of the principal German utilities will buy at least a portion of long-term enrichment requirements from Urenco. Urenco recently began operating its third commercial enrichment plant at Gronau in North-Rhine Westphalia (Figure 1). (The other two plants are in Almelo, the Netherlands, and Capenhurst, England.)

Aside from the special relationships outlined above, the German utilities have encouraged competition among domestic and non-German sellers of nuclear fuel. Even when one supplier already has a close relationship with a utility, some have diversified purchases in order to promote competitive pricing. Most utilities, however, currently have a bias for uranium supply furnished by European and African sources. This bias, attributable to the usual desire for domestic self-sufficiency, has been accentuated by various negative experiences with other governments. Most notable among those is the ill-advised US government attempt to regulate other countries' fuel-cycle activities through the Nuclear Non-Proliferation Act of 1978.

The German companies' independent commercial attitude is exemplified by their open approach to trade with the Soviet bloc nations and with developing countries. KWU is currently negotiating with the People's Republic of China for extensive cooperation in nuclear energy matters. One of the topics of negotiation is the possible development of a fuel-cycle trade between the two countries that could include the bartering of Chinese uranium and the delivery of German spent fuel to the PRC for long-term storage.

More relevant to the international uranium market, however, may be the increasing presence of the German nuclear fuel companies in the USA and Canada. While the German utilities have increasingly sought autonomy from US and Canadian suppliers, their associated fuel companies have become more and more active in the USA and Canada. In a market that traditionally has lacked dealer intermediaries, several well-financed German companies have created an international business in uranium trading. That business could be indicating the future direction of the nuclear fuel market.

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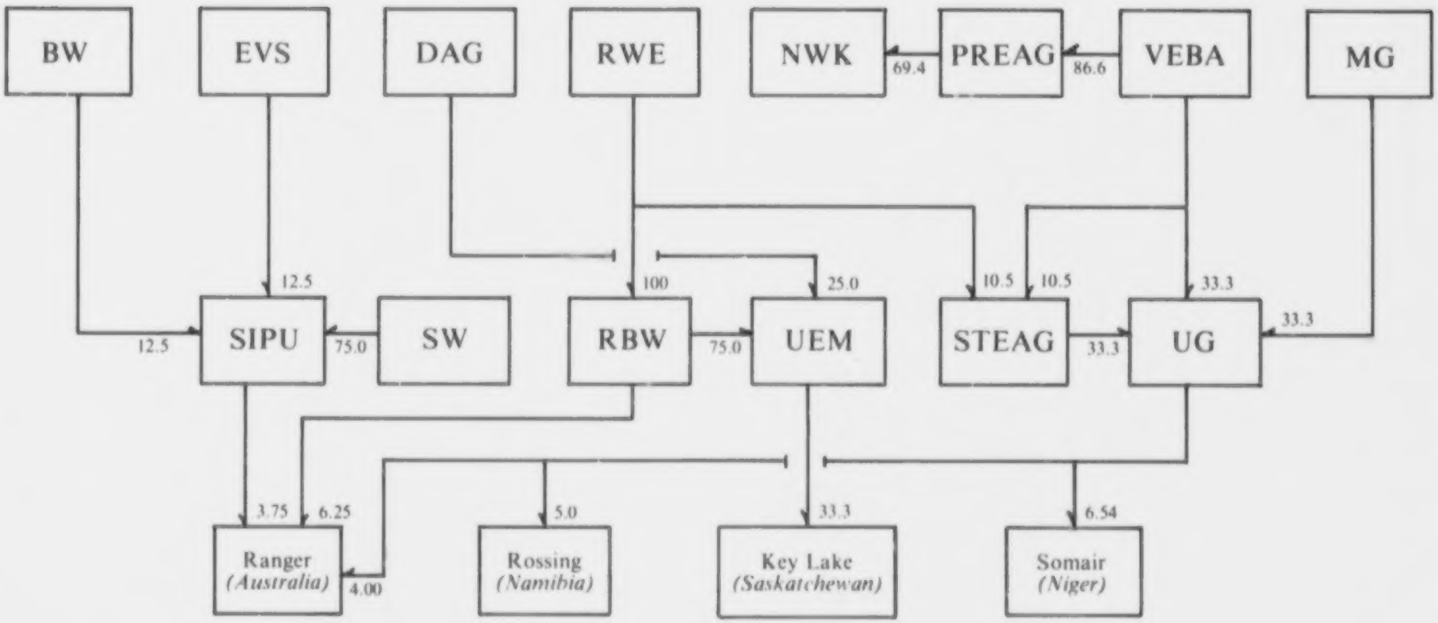
Figure 4

GERMAN OWNERSHIP IN ACTIVE URANIUM PRODUCTION OPERATIONS


BW
EVS
DAG
RWE
NWK
69.4
PREAG
86.6
VEBA
MG
12.5
12.5
SIPU
75.0
SW
100
RBW
75.0
25.0
UEM
10.5
10.5
STEAG
33.3
33.3
33.3
UG
3.75
6.25
Ranger
(Australia)
4.00
5.0
Rossing
(Namibia)
33.3
Key Lake
(Saskatchewan)
6.54
Somair
(Niger)

BW —Badenwerk AG
DAG —Deilmann AG
EVS —Energieversorgung Schwaben AG
MG —Metallgesellschaft AG
NWK —Nordwestdeutsche Kraftwerke AG
PREAG—Preussische Elektrizitaets AG
RBW —Rheinische-Braunkohlenwerke AG
RWE —Rheinisch-Westfaelisches Elektrizitaetswerk AG
SIPU —Saarberg Interplan Uran GmbH
STEAG—Steag AG
SW —Saarbergwerke AG
UEM —Uranerz Exploration & Mining Co.
UG —Urangesellschaft GmbH
VEBA —Veba AG

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RECENT DEVELOPMENTS

CANADA

Maritime Nuclear, a government-owned company jointly formed by Atomic Energy of Canada and New Brunswick Electric Power Company, has deferred plans for the construction of Point Lepreau Unit 2. The 630-MWe Candu reactor would have been the first nuclear power plant ordered in North America since 1978. The company was created to establish the Point Lepreau Unit 2 project, and it invited contractor proposals in February 1984. Maritime Nuclear recently announced that it will scale down its operations until there is evidence that the energy will be needed. The company has spent $15 million on the project, and is planning staff reductions.

The second Point Lepreau unit originally was intended to supply power exclusively to US markets. However, declining electricity demand and rising construction costs discouraged investment by US utilities. In addition, more than fifteen New England utilities which already had invested in the troubled Seabrook plant were reluctant to support a Canadian project which could succumb to the same difficulties and might be unnecessary.

* * *

The partners of the Cigar Lake Joint Venture, Saskatchewan Mining Development Corporation (SMDC) (50.75 percent), Cogema Canada Ltd. (32.625 percent), Idemitsu Uranium Exploration Canada Ltd. (12.875 percent), and Corona Grande Exploration Corporation (3.75 percent) have announced the formation of a joint operating company called Cigar Lake Mining Corporation (CLMC). CLMC, located in Saskatoon, Saskatchewan, will be directed toward the identification of appropriate underground mining methods and milling processes for the extremely high-grade deposit located 115 kilometers northeast of Key Lake. The company at present consists of six professional engineers, and will be expanded to include geotechnicians and environmental specialists.

Cogema Canada made the initial Cigar Lake discovery in 1981. In February 1985, new test drilling results indicated that the reserves were of a higher grade and tonnage than previously estimated (see Report 199, p. 20). The average grade of 14-percent U_3O_8 (12-percent elemental uranium) may require special mining techniques in order to protect miners from high radiation levels. CLMC will be responsible for development of the project, which currently is in pre-development stages, consisting of environmental impact and technical mine engineering studies. CLMC anticipates costs of $4 million for the pre-development stage, and production is expected to begin in the early 1990s.

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UNITED STATES

Introduction

Three nuclear power units in the USA have begun commercial operation since the beginning of 1985, adding almost 3,300 MWe to US nuclear generating capacity (Table 3). Four other units with full-power operating licenses are expected to enter commercial operation during June. This would at mid-year account for exactly half of the fourteen units which Nuexco predicted would enter commercial operation during 1985. These developments are reinforced by the fact that four other reactors have received fuel-loading licenses and are performing low-power tests. Should three of those units enter commercial operation by the end of the year, the number of units entering commercial operation in 1985 will exceed the number of units which began operation in 1983 and 1984 combined. Table 4 lists US nuclear units nearing operation in 1985-86.

A recovery or stabilization of the US nuclear power industry has not been evident at least since early 1983. Even at that time, cancellations, deferrals, and construction delays constituted much of the activity; almost twice as many units were canceled in 1983 as began commercial operation. Continuing that trend, more units were officially canceled than began commercial operation in 1984. Except for the troubled Midland and Seabrook plants, however, there are few likely cancellations in the remaining months of 1985. LILCO's Shoreham unit continues to suffer from regulatory obstructions that will prevent the operation of the plant for an indefinite length of time, but because construction is complete, the likelihood of its eventual operation is high.

Commercial Operations

After years of litigation and plant modifications, Pacific Gas & Electric's (PG&E) Diablo Canyon Unit 1 began commercial operation on May 7, 1985. The utility received a full-power license in August 1984, and power ascension

Table 3

US NUCLEAR UNITS' LICENSING STATUS IN MID-1985

Unit	Lead Utility	MWe Net	Type	COD[1]
Commercial Operation				
Susquehanna 2	Pennsylvania P&L	1050	BWR	Feb 1985
Callaway 1	Union Electric	1150	PWR	Mar 1985
Diablo Canyon 1	Pacific G&E	1084	PWR	May 1985
Total		3,284		
Full-Power Operating License				
Byron 1	Commonwealth Edison	1120	PWR	Jun 1985
Catawba 1	Duke Power Co.	1145	PWR	Jun 1985
Grand Gulf 1	Mississippi P&L	1250	BWR	Jun 1985
Waterford 3	Louisiana P&L	1104	PWR	Jun 1985
Palo Verde 1	Arizona PS	1270	PWR	Dec 1985
Total		5,889		
Fuel-Loading and Low-Power-Testing License				
Fermi 2	Detroit Edison	1100	BWR	4Q 1985
Limerick 1	Philadelphia Elec.	1055	BWR	4Q 1985
Wolf Creek	Kansas G&E	1150	PWR	Sep 1985
Diablo Canyon 2	Pacific G&E	1106	PWR	Dec 1985
Total		4,411		

[1] Commercial Operation Date, based on utility forecasts and published information.

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tests began after federal appeals courts reviewed the case and refused to uphold opponents' objections. In addition, Union Electric Company's Callaway Unit 1, a 1,150-MWe PWR, and Pennsylvania Power & Light Company's Susquehanna Unit 2, a 1,050-MWe BWR, began commercial operation in the first quarter of this year.

Full-Power and Fuel-Loading Licenses

Five utilities have full-power operating licenses for their units; the NRC granted a license to Middle South Utilities for the Grand Gulf Unit 1 in August 1984. Duke Power Company (Catawba Unit 1), Louisiana Power & Light Company (Waterford Unit 3), and Commonwealth Edison Company (Byron Unit 1) all received full-power licenses in early 1985. Arizona Public Service received a full-power license with a five-percent power restriction in December 1984 for its Palo Verde Unit 1, and the power restriction was lifted at the end of May, allowing full-power ascension to proceed. The first four utilities are expected to begin commercial operation in June 1985. In addition, four more units have begun testing under fuel-loading and low-power testing licenses. They include PG&E's Diablo Canyon Unit 2, which has escaped much of the controversy surrounding Unit 1, and Philadelphia Electric Company's Limerick Unit 1, the first of a two-unit plant. The utilities anticipate that all of these plants will begin commercial operation by the end of 1985.

* * *

Representative Frank Guarini (D-N.J.) and five other Congressmen in May introduced legislation which would impose a tariff on UF_6 imported from any country that requires the upgrading of uranium mined in that country into UF_6 before export. Canada is the only country with

Table 4

US NUCLEAR PLANTS NEARING OPERATION IN 1985-86

Unit	Utility	MWe Net	Type	Percent Complete	COD[1]
Byron 1	Commonwealth Edison	1120	PWR	100	Jun 1985
Catawba 1	Duke Power Co.	1145	PWR	100	Jun 1985
Grand Gulf 1	Middle South	1250	BWR	100	Jun 1985
Waterford 3	Louisiana P&L	1104	PWR	100	Jun 1985
Wolf Creek	Kansas G&E	1150	PWR	100	Sep 1985
Shoreham[2]	Long Island Lighting	820	BWR	100	Oct 1985
Fermi 2	Detroit Edison	1100	BWR	100	4Q 1985
Limerick 1	Philadelphia Elec.	1055	BWR	100	4Q 1985
Watts Bar 1	TVA[3]	1177	PWR	100	4Q 1985
Palo Verde 1	Arizona PS	1270	PWR	100	Dec 1985
Diablo Canyon 2	Pacific G&E	1106	PWR	100	Dec 1985
Comanche Peak 1	Texas Utilities	1150	PWR	99	Dec 1985
Palo Verde 2	Arizona PS	1270	PWR	99	4Q 1986
Perry 1	Cleveland Electric	1205	BWR	98	Dec 1985
River Bend 1	Gulf States Utilities	940	BWR	97	Dec 1985
Hope Creek 1	Public Service E&G	1170	BWR	97	mid-1986
Palo Verde 3	Arizona PS	1270	PWR	96	mid-1987
Millstone 3	Northeast Utilities	1150	PWR	95	May 1986
Catawba 2	Duke Power Co.	1145	PWR	95	Sep 1986
Clinton 1	Illinois Power	933	BWR	93	Jul 1986
Shearon Harris 1	Carolina P&L	900	PWR	90	Sep 1986
Nine Mile Point 2	Niagara Mohawk	1080	BWR	89	Oct 1986
Braidwood 1	Commonwealth Edison	1120	PWR	80	Oct 1986
Byron 2	Commonwealth Edison	1120	PWR	67	Oct 1986

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[1] Commercial Operating Date, based on utility forecasts and published information.

[2] A low-power license granted to the Shoreham plant was revoked in March 1985 by the Atomic Safety and Licensing Board. The plant's operation depends on the acceptance of its emergency plan, and the overcoming of other obstacles.

[3] TVA = Tennessee Valley Authority.

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such a policy, but in recent years the Canadian government has granted some exemptions, allowing certain US utilities having long-term contracts with US converters to take their deliveries of Canadian uranium in the form of concentrates rather than UF_6.

The House bill would require a $3.00 per pound UF_6 tariff on all upgraded uranium imported from countries requiring domestic conversion. UF_6 imported from countries having no such policy would be duty-free. The impetus behind the bill included a perception that Canada's exceptions to its policy were becoming too limited and scarce. However, at a Canadian producers meeting in March 1985, the producers agreed to grant the exemptions automatically until utilities' US conversion contracts expire. This apparently contradictory situation can be viewed as an attempt to protect the US converters' markets when their contracts have expired. It might be a way of encouraging US utilities to sign new contracts with the converters in order to assure the option of obtaining Canadian U_3O_8.

In addition, the overcapacity at the US conversion facilities undoubtedly motivated the converters to seek some protectionist measures from Congress. Eldorado Nuclear also has far too much capacity, having tripled its conversion facilities at Port Hope, Ontario with the completion of a new UF_6 plant last year. As Canadian production rose to become the largest in the world, Eldorado added conversion capacity to keep pace, while assuming that the government's upgrading policy would remain in effect.

If the bill were enacted, it would strengthen the US converters' positions in renegotiating contracts with US utilities. This is evident considering overseas converters have limited impact on the US market due to transportation costs, and because US utilities would be discouraged from obtaining Eldorado contracts due to the $3.00 tariff. In addition, conversion market competition would diminish, resulting in higher prices paid for conversion than would have been in effect, absent government interference. The oversupply in the conversion market would prevent any shortage of conversion services.

For these reasons, the chances of the bill passing are slim. It will go to the House Subcommittee on Trade, under the House Ways and Means Committee, for comment in June. There are indications that the Canadians are not overly concerned that the bill will pass, and are aware of the length of time the measure will take to gain support. In addition, they feel that the US utilities would probably apply pressure on Congress to reject the measure. Canada is not likely to mount a strong challenge through US-Canadian trade channels. It also is unlikely that the Canadian government's policy will change; in actuality, exemptions are likely to disappear as US utilities' contracts with US converters begin to expire.

CORRECTION

In the 1984 Annual Review, Nuexco incorrectly implied that Queensland Mines Ltd. (QML) had ceased production operations at its Nabarlek project (page 13). That passage should have read "Nabarlek has ceased *mining* operations." In actuality, QML plans to continue *milling* ore at least until the end of 1988. Similarly, in the World Uranium Production section (page 11), the reference to Nabarlek should have read "... the completion of Queensland Mines Ltd. *mining* at Nabarlek means that Australian production cannot be expected to equal its 1982 peak ..."

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URANIUM MINES IN THE USSR

Introduction

Four mining districts in the USSR have been the major source of uranium production within the country. An additional four or five production centers have been less prolific, but their combined capacity has proven essential to total uranium supply. Uranium usually is recovered through by-product or co-product mining operations. Uranium requirements are supplemented by unknown quantities imported from various CMEA (Council for Mutual Economic Assistance) countries, primarily Czechoslovakia and Romania.

The first sustained uranium recovery operation began in 1908 at the Tyuya-Muyun mine located in the northern Alai Mountains of the Uzbekistan district near the border of China and Afghanistan (Figure 5). More than 900 tonnes of uranium concentrates were recovered as a by-product of copper and vanadium mining during the next seven years. Uranium was recovered almost continuously during the regular mining operation until the late 1950s. The present status of the project is uncertain, but adjacent mines and others in the northern sector of the Chatkal/Ferghana region are currently producing by-product uranium, primarily from fluorspar ores and lignite.

A rich mineral trend extends northward from the Tyuya-Muyun mine area to the Ferghana region, continuing northward into the province of Kazakhstan. Copper has been mined there for many years. Uranium mineralization occurred in association with the copper ore and has been recovered as a co-product since the late 1950s. The mineralized complex contains extremely large tonnage of highly disseminated copper and uranium ore, indicating that the mine is likely to be a long-term supplier of uranium.

One of the most important production centers lies in the northern sector of the Krivoi Rog iron district in Dnepropetrovsk Province of west-central Ukraine. Uranium mining began at the Terny and Zholtye Vody mines in the mid-1940s, one of the country's first production centers. Originally, uranium was the primary product at both mines, but later became a co-product of iron production. Although the Terny mine was closed in 1969, the Zholtye Vody mine continues to produce. (The district is described in Report 194, page 21.)

Molybdenum and uranium are co-produced at mines in several districts primarily in western and central USSR. Uranium from this source is considered important to the total supply program because of the wide distribution of occurrences. However, the total number of mining centers, annual production capacities, and specific geographic locations are unknown. Only brief references to the geologic and mineral associations of such mining projects can be found.

Chatkal/Ferghana District

At the Tyuya-Muyun mine, complex mineralization was discovered about 1899 in a host of metamorphosed limestone of Paleozoic age. Geologic evaluation of the area began almost immediately, which resulted in the discovery and delineation of an extensive and highly mineralized vein system associated with hydrothermal alteration along prominent structural features. The configuration of mineralization consists of a central core of massive barite veins containing copper, vanadium and uranium. Five or six major veins and a number of intermediate veinlets form a radial pattern away from the core. The largest veins are 1,600 to 2,000 meters in length. The first mine began to recover copper, vanadium and barite in 1908. Originally, uranium was removed from the mineral concentrate because of the need to purify the other products. It was used sparingly in the glass and ceramic industries, and as one of the main sources of radium in the USSR. From the late 1940s to the present, it has been an important source of U_3O_8 for the domestic nuclear industry.

In the early years of mine life, the relatively high-grade ore averaged almost four percent copper, 2.5 percent vanadium, and approximately one percent uranium. The average grade of mined uranium over the years is not known, but it was inferred that a large ore reserve remained and the average uranium content was 1.5 percent U_3O_8, with high-grade zones exceeding 4.0 percent. The main uranium mineral is tyuyamunite, a calcium, uranium vanadate, named for the mine site on Tyuya-Muyun hill. Tyuyamunite and carotite mineralization formed along veins occupied by the other minerals. The uranium minerals tend to be concentrated, by quantity and grade, in cavities created by the action of hydrothermal solutions moving through the vein system during the mineralizing epoch. Many select mineral specimens have been collected from the cavity areas.

Most mining has been performed using underground methods. Mines have been developed at strategic locations on the different vein structures. The deepest mines exceed 500 meters in depth and in some cases are con-

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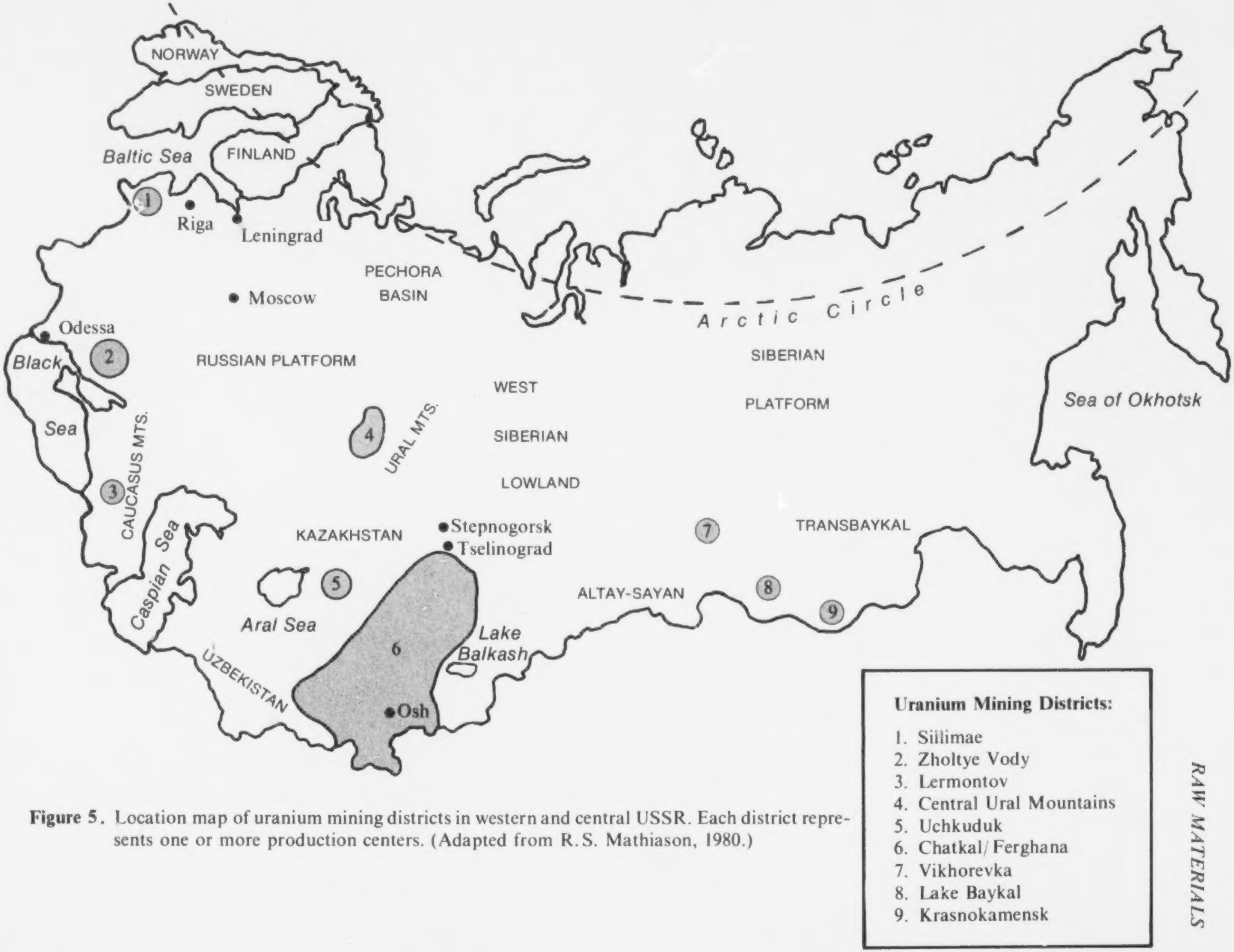
NORWAY
SWEDEN
FINLAND
Baltic Sea
1
Riga
Leningrad
PECHORA
BASIN
Moscow
Odessa
2
Black
Sea
RUSSIAN PLATFORM
WEST
SIBERIAN
LOWLAND
4
URAL MTS.
CAUCASUS MTS.
3
Caspian Sea
KAZAKHSTAN
Stepnogorsk
Tselinograd
5
Aral Sea
6
Osh
Lake
Balkash
UZBEKISTAN
ALTAY-SAYAN
7
8
9
TRANSBAYKAL
SIBERIAN
PLATFORM
Arctic Circle
Sea of Okhotsk
Uranium Mining Districts:
1. Sillimae
2. Zholtye Vody
3. Lermontov
4. Central Ural Mountains
5. Uchkuduk
6. Chatkal/Ferghana
7. Vikhorevka
8. Lake Baykal
9. Krasnokamensk

Figure 5. Location map of uranium mining districts in western and central USSR. Each district represents one or more production centers. (Adapted from R.S. Mathiason, 1980.)

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RAW MATERIALS

nected by lateral workings. The mined ores are shipped to Chkalovsk via the Great Ferghana Canal for processing. Uranium concentrate is recovered from the ores and is further processed at a nearby conversion plant.

There are 25 to 30 other active mines in the Chatkal/Ferghana district, in which uranium is either the primary mineral recovered or a by-product. The district is the largest source of uranium in the USSR. The mines at Taboshar and Maylisay produce uranium disseminated in a sandstone formation. Each mine has its own processing plant. The uranium content varies from about 0.10 percent to 0.20 percent. High-grade ore occurs in lenses of coarse sandstone, sometimes associated with depositional breaks consisting of shale or mudstone stringers and along faults and fractures associated with contact metamorphism and alteration. In the nearby Kara-Tau mountains, uranium is associated with copper and vanadium at the Bela Sauskandyk mine. Pitchblende is the dominant uranium mineral present; secondary uranium minerals often are associated with zones of intense hydrothermal alteration.

On the northern flanks of the Kurama mountains are a number of mines from which uranium is recovered as a by-product of fluorspar, copper and lignite. The Naugarzan mine is the largest fluorspar and uranium mine in the district. Mining began in 1964 in an area where mineralization occurs primarily in a steeply dipping vein system associated with caldera-type depressions and related faulting. The host rocks consist of interbedded sediments (tuffaceous sandstones and gravels) and volcanics that fill structural depressions.

In the caldera environment, mineralization has developed in three types of deposits. The most common type is steeply dipping vein systems directly influenced by structural conditions in volcanic cover rocks and Paleozoic granites. Next, stockwork deposits occur along major faults and fractures. The third type of deposit is stratabound in the undisturbed sedimentary sequence filling caldera-related basins. In each case, the principal uranium mineral is pitchblende. The mined ores are shipped directly to a fluorspar mill located at Toytepa; a rough uranium concentrate is separated from the fluorspar and shipped directly to the uranium mill at Chkalovsk.

Uranium is recovered as a by-product from lignite burning in at least three different locations. The Min-Kush and the Tsentralnaya mines are located in the southern portion of the district, the Almalyk mine is located about 20 kilometers north of Osh. The latter is the largest mine. It began open-pit production in 1962 and has maintained an annual production level of just over 180,000 tonnes of lignite. The Min-Kush mine is also an open pit, producing about 120,000 tonnes per year. Initial production at the Tsentralnaya mine was about 90,000 tonnes per year using underground mining methods. Open-pit mining of the deposit began about 1970, and the annual production level is well over 100,000 tonnes. The ash from each project is leached at a nearby plant to recover the uranium. The concentrate subsequently is transported to the conversion plant located at Kara-Belta. The Kara-Belta plant has been the main conversion facility for the southern district since the early 1950s.

In the central part of the district, uranium is recovered as a by-product from lead ore mined at the Bordunskiy, Ak-Tyuz, and Orlovka mines. The uranium is recovered at the Kirgiziya metallurgical complex located near Orlovka, probably using flotation techniques. Finally, uranium is recovered as a co-product from gold ores produced at several mines situated in the Kyzyl Dzhar mining district. It is likely that the gold ores are processed at the Kirgiziya complex, and the uranium is separated from the ore by flotation. Also, the uranium concentrate is probably leached and precipitated as ammonium diuranate (ADU).

The northern sector of the Chatkal/Ferghana district has only recently developed into an important uranium-producing area. In the southern Kazakhstan republic, an extensive mineralized trend has been discovered to contain a variety of minerals. Most important are the vast reserves of porphyry-type copper mineralization disseminated throughout metamorphic and igneous rock hosts, much of which is known to contain significant quantities of uranium. Open-pit and underground mines have been developed along the trend where copper is the primary mineral mined. Uranium is a co-product in at least five of the mines, but production rates for the district are not known.

The largest uranium production center may be the Stepnogorsk mine located northeast of Tselinograd. Uranium and copper occur in a vein system containing considerably higher grade than the disseminated ores. Placement of the ore is related to structural events. It is concentrated along the resulting fault and fracture patterns. The mining utilizes underground methods.

Other uranium mines include the Koktas, Kiyakhty, Aksuyek and Akbakay mines located to the south near Lake Balkash. Each is an open-pit mine where low-grade uranium is mined as a co-product of copper. The rough uranium concentrate from the five mines is collected for

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shipment to the Tseliny Mining and Chemical Complex near Stepnogorsk. Uranium concentrate is shipped elsewhere for further processing.

Other Uranium Districts

Molybdenum-uranium deposits are found in a variety of geologic settings. Most occur in association with hydrothermal mineralization related to sedimentary deposition in close proximity to volcanic and intrusive rocks of Paleozoic age. Primary mineralization is disseminated in the volcanics and intrusives. Diorite dikes and volcanic pipes and plugs are frequently mineralized. The mineral suite may contain uranium and sulfide minerals such as molybdenite, galena and pyrite. Higher-grade ores often are found near intrusive contact zones and in sediments. Zones of contact metamorphism, especially in sediments (sandstones and conglomerates), are highly favorable for ore accumulation.

Pitchblende is the main uranium mineral present, forming low-grade ore where disseminated, and often increasing in percentage at the contact zone and within the sediments. The most important deposits are situated where rock structure has been influenced by hydrothermal activity adjacent to fault and fracture zones. The mineralization is confined to vein systems, veinlets and in stockworks where intense alteration has taken place.

Low-grade molybdenum-uranium occurrences have been discovered in Proterozoic rocks of the Siberian and Aldan shield regions. The mineral accumulation probably is the result of precipitation from hydrothermal solutions invading intensely fractured rock. Titanium and iron are common mineral constituents in the more complex occurrences. The Soviets have attempted solution mining in areas of advanced rock alteration where porosity and permeability suggest favorable leaching conditions. Neither the magnitude nor the success of the leaching operation is known. However, solution mining technology has advanced in the USSR, and it is likely that the application of solution mining will become more prominent, especially for the exploitation of large, low-grade deposits.

Uranium is recovered as a by-product of phosphoric acid production at Sillimae near the Baltic Sea coast in Estonia. It is the largest phosphate-uranium operation in the USSR. Uranium is contained primarily in fish bone detritus common to the phosphate deposit. The uranium values are low, recorded in a range of approximately 40 to 90 parts per million in the phosphate-bearing rock. However, the demonstrated association between uranium and the detritus material suggests that higher U_3O_8 percentages are likely to occur where the detritus has accumulated as a result of depositional changes.

The recovery of uranium from the phosphate begins with the acidulation of the phosphate rock. In this wet process, the phosphate is completely digested by sulfuric acid. Under ideal conditions, approximately 90 percent of the contained uranium is stripped from the acid stream through the application of basic solvent extraction technology. The amount of U_3O_8 recovered annually from this operation is not public information. The only certainty is that large quantities of phosphatic fertilizer and uranium are manufactured annually and vast ore reserves assure the project's longevity.

Uranium also is recovered from the waste water generated during the refining process of petroleum products from the Ukhta oilfields located in the Pechora Basin, in the northern part of Western USSR. Uranium and radium metals contained in the oil are taken into solution and remain there through the final stage of refinery use. The metals are recovered by precipitation from the process water. Uranium production levels are not known, but oil production amounts to millions of barrels annually, suggesting that uranium recovery from this project is high.

Summary

The mines described represent only a portion of the total number of active uranium mines in the USSR. Mines not listed are assumed to be smaller, less important projects. Potentially, a number of properties remain unidentified and are lost in the speculation surrounding uranium resource and supply capabilities of the USSR. It is possible that some reserves are not tabulated as part of the overall uranium supply situation in the USSR because information about some of the large production centers has not been released outside of the country.

Eight processing plants are noted in this article as receiving ore from specific mines or groups of mines; there are at least ten plants in the USSR, including two chemical and metallurgical plants, that produce uranium concentrate. The concentrate is shipped from the milling facilities to any of three conversion plants. The original is at Zholtye Vody in the Ukraine, the second is at Chkalovsk in the southern Ferghana district, and the third is at Kara Belta in northern Kirgiziya. Uranium hexafluoride is transported from the conversion plants to one of two enrichment plants. The main plant is at Zholtye Vody, and another is located at Chkalovsk. Production capacities of all conversion and enrichment plants are not available.

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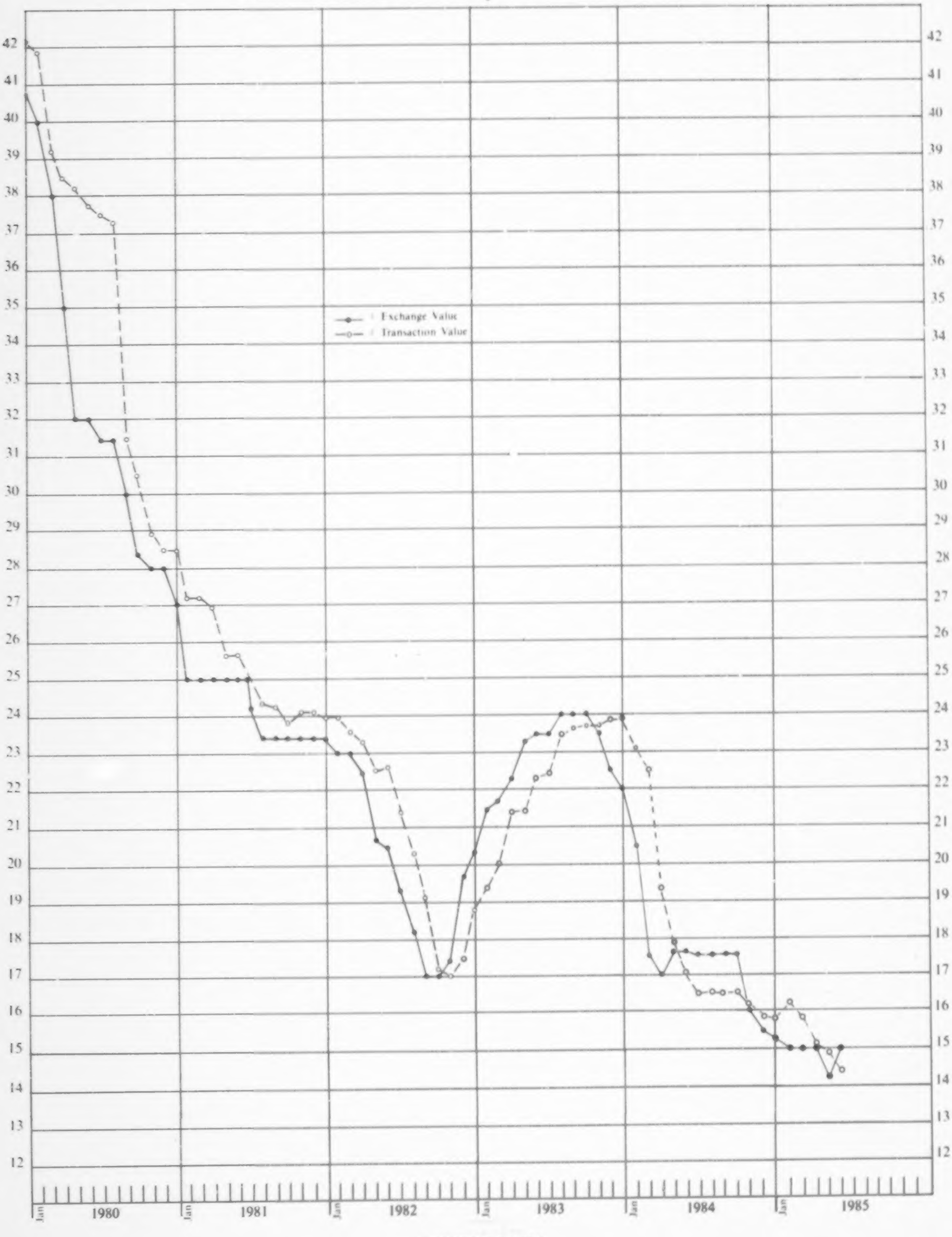
HISTORICAL MARKET DATA

EXCHANGE AND TRANSACTION VALUES SINCE JANUARY 1980

Determined as of the last day of the month indicated



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HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	—	—	—	—	—	—	—	6.35	6.35	6.40	6.45	6.50
1969	—	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	32.50	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00
1981	25.00	25.00	25.00	25.00	25.00	24.25	23.50	23.50	23.50	23.50	23.50	23.50
1982	23.00	23.00	22.50	20.75	20.50	19.25	18.25	17.00	17.00	17.50	19.75	20.25
1983	21.50	21.75	22.25	23.25	23.50	23.50	24.00	24.00	24.00	23.50	22.50	22.00
1984	20.50	17.50	17.00	17.75	17.75	17.50	17.50	17.50	17.50	16.00	15.50	15.25
1985	15.00	15.00	15.00	14.25	**15.00**							

HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	—	—	—	—	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38 40	37.90	37.60	37.30	31.60	30.60	29.00	28.70	27.70
1981	27.20	27.20	27.00	25.70	25.70	24.50	24.40	24.30	23.90	24.10	24.10	24.00
1982	24.00	23.70	23.40	22.60	22.70	21.50	20.30	19.10	17.30	17.00	17.55	18.80
1983	19.35	20.00	21.35	21.40	22.35	22.45	23.50	23.60	23.65	23.65	23.85	23.85
1984	23.05	22.50	19.25	17.90	17.00	16.50	16.60	16.40	16.55	16.05	15.90	15.90
1985	16.20	15.70	15.05	14.90	**14.45**							

HISTORICAL CONVERSION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U as UF_6)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	1.20	1.20	1.20	1.40	1.15	1.15	1.15	1.10	1.10	1.10	1.20	1.20
1982	1.20	1.20	1.20	1.20	1.00	1.00	1.00	0.90	1.10	1.60	1.45	1.45
1983	1.20	1.40	1.40	1.20	1.20	1.20	1.10	1.10	1.00	0.60	0.60	0.60
1984	0.60	0.30	0.80	0.80	0.80	0.00	0.00	0.80	1.00	1.00	0.80	0.80
1985	1.00	1.00	1.00	1.50	**1.50**							

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GOVERNMENT STATISTICS

AUSTRALIA

	Price Index of Materials Used in Manufacturing Industry—All Groups[1] (1969=100)	Award Rates of Pay Indexes Australia—Adult Males In Mining Wage and Salary Earners, Weekly Rates[2] (1976=100)
1983 Avg.	401.2	181.8
Jan 1984	399.2	188.6
Feb 1984	402.5	188.5
Mar 1984	403.9	188.3
Apr 1984	404.2	196.2
May 1984	403.8	197.0
Jun 1984	404.9	197.0
Jul 1984	408.5	197.0
Aug 1984	413.3	197.0
Sep 1984	412.1	197.0
Oct 1984	408.6	197.0
Nov 1984	407.3	197.0
Dec 1984	406.0	197.0
Jan 1985	409.4R	197.0
Feb 1985	415.6	197.0
Mar 1985	—	197.0

P = Preliminary R = Revised since last month

CANADA

		Wage-earner Data: Average Hourly Earnings (C$)[2]					
	Industry Selling Price Index: Manufacturing[1] (1971=100)	Uranium Mines (SIC 057)	Metal Mines* (SIC 051-059)	Mines, Quarries and Oil Wells[3] (SIC 051-099)	Primary Metal Industries Non-ferrous[4] (SIC 296)	Primary Metal Industries Non-ferrous[4] (SIC 298)	Chemicals and Chemical Products[5] (SIC 372-379)
1983 Avg.	298.8	—	—**	14.30	—	—	11.17
Jan 1984	305.4	17.74	15.27	14.74	11.91	10.84	11.69
Feb 1984	306.6	17.78	15.59	14.90	12.04	10.82	11.51
Mar 1984	308.7	18.05	15.52	14.82	12.14	10.84	11.58
Apr 1984	310.5	18.06	15.83	15.10	11.96	10.34	11.63
May 1984	310.6	18.48	15.64	15.06	12.11	10.16	11.65
Jun 1984	311.0	18.08	15.48	14.80	12.38	10.40	11.66
Jul 1984	312.7	17.81	15.72	14.92	12.53	10.18	11.82
Aug 1984	312.7	17.24	15.36	14.92	12.44	10.34	11.78
Sep 1984	312.3	17.68	15.96	15.34	12.51	10.52	11.90
Oct 1984	312.3	17.64	16.15	15.26	12.69	10.56	11.96
Nov 1984	313.6	18.04	16.13	15.43	12.47	10.51	11.96
Dec 1984	314.2	17.95	16.39	15.60	12.16	10.40	11.99
Jan 1985	315.8	18.05	16.13	15.60	12.32	10.80	12.04
Feb 1985	316.4	18.78R	16.41R	15.68R	12.52R	11.05R	12.06R
Mar 1985	317.5	18.24P	16.17P	15.57P	12.51P	10.83P	11.95P

P = Preliminary R = Revised since last month

For annual averages prior to 1983, and for notes pertaining to these statistics, see pages 23–26 of Report 190 of June 1984.

*The 1980 average for Metal Mines was incorrectly reported as 10.59. The correct average is 10.58 (see Report 190).

**Two different methods were used in the 1983 "Metal Mines" category in reporting survey data, and Statistics Canada did not publish a 1983 average. The March 1983 figure for the old method was 14.73 and for the new method was 14.84. The published average for 1983 in Report 190 was a Nuexco calculation based on the available monthly statistics for 1983 with the exception of the March figure, where only the 14.84 value was taken into account.

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REPUBLIC OF SOUTH AFRICA

GOVERNMENT STATISTICS

	Average Declared Working Costs per per Metric Ton of Gold Ore Milled (Rand)[1]	Tonnage-Weighted Index of Average Working Costs per Metric Ton of Gold Ore Milled (March 1982=100)[2]	Consumer Price Index[3] (1975=100)[4]	Producer Price Index All Groups[5] (1975=100)	Total Employment in Mining and Quarrying (Code 35)[6]	Total Salaries and Wages in Mining and Quarrying (1,000 Rand) (Code 40)[6]
1983 Avg.	51.87	115.0	262.2	274.8	696,579	3,644,772
Jan 1984	—	—	274.7	283.3	689,807	326,619
Feb 1984	—	—	278.4	286.5	702,553	335,906
Mar 1984	55.30	123.1	281.9	288.0	715,628	342,332
Apr 1984	—	—	286.1	290.2	712,963	327,550
May 1984	—	—	288.3	292.6	710,040	327,937
Jun 1984	56.95	126.2	291.2	295.3	717,009	347,121
Jul 1984	—	—	295.1	296.0	717,121	369,964
Aug 1984	—	—	297.0	300.8	721,905	361,357
Sep 1984	60.64	133.2	299.9	304.1	721,470	359,218
Oct 1984	—	—	303.7	308.7	717,865	363,755
Nov 1984	—	—	307.4	312.8	717,396	369,771
Dec 1984	62.92	138.6	309.4	315.9	701,198	365,234
Jan 1985	—	—	177.1*	166.6*	—	—
Feb 1985	—	—	182.8*	171.3*	—	—
Mar 1985	64.48	142.4	183.6*	173.0*	—	—
Apr 1985	—	—	187.4*	—	—	—

*The basis for calculation for these indices has been revised to January 1980 = 100.

UNITED STATES

	Producer Price Index[1]		Consumer Price Index[2]	GNP Implicit Price Deflator[3]	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[4]			
	Industrial Commodities (1967=100)	All Commodities (1967=100)	(1967=100)	(1972=100)	Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)	Electric and Electronic Equipment (SIC 36)
1983 Avg.	315.8	303.1	298.4	215.63	12.57	13.43	10.59	8.65
Dec 1983	318.4	306.1	303.5	218.53	12.75	13.33	10.90	8.84
Jan 1984	319.1	308.0	305.2	—	12.67	13.38	10.91	8.88
Feb 1984	320.6	308.9	306.6	—	12.81	13.34	10.90	8.86
Mar 1984	321.9	311.0	307.3	220.58	12.85	13.33	10.95	8.88
Apr 1984	322.5	311.4	308.8	—	12.91	13.30	10.97	8.89
May 1984	323.3	311.7	309.7	—	12.99	13.37	11.02	8.89
Jun 1984	323.9	311.4	310.7	222.40	12.96	13.40	11.03	8.91
Jul 1984	324.0	312.0	311.7	—	13.02	13.36	11.12	8.95
Aug 1984	323.5	310.9	313.0	—	13.10	13.51	11.13	9.00
Sep 1984	322.3	309.5	314.5	224.57	13.20	13.39	11.23	9.08
Oct 1984	323.2	309.4	315.3	—	13.23	13.53	11.32	9.09
Nov 1984	323.8	310.4	315.3	—	13.23	13.76	11.35	9.15
Dec 1984	323.0	309.9	315.5	226.10	13.28	13.66	11.37	9.27
Jan 1985	323.2	309.8	316.1	—	13.25	13.71	11.42	9.28
Feb 1985	322.5	309.2	317.4	—	13.27R	13.74	11.42	9.28R
Mar 1985	322.6	308.7	318.8	229.01	13.20P	13.99P	11.40R	9.34
Apr 1985	323.8	309.3	320.1	—	—	—	11.50P	9.33P

P = Preliminary R = Revised since last month

For annual averages prior to 1983, and for notes pertaining to these statistics, see pages 23-26 of Report 190 of June 1984.

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NUEXCO

EXECUTIVE SUMMARY
REPORT 202
(All data as of May 31, 1985)

Exchange Value **\$15.00, up \$0.75**	The **Exchange Value** is **\$15.00** per pound U_3O_8, up \$0.75 since last month. Eight recent natural uranium sales are reported, involving approximately 3.5 million pounds U_3O_8 equivalent. Seven involved delivery prior to 1986, and six met the conditions for inclusion in the Transaction Value. One involved natural UF_6.
UF_6 Value **\$42.50, up \$2.00**	Last month Nuexco began publishing a value for natural UF_6. The **UF_6 Value** is **\$42.50** per kilogram U in UF_6, up \$2.00 since last month.
Supply-Demand Ratio **rose to 2.8:1**	Active spot and near-term **uranium supply** amounts to **2.7 million** pounds U_3O_8 equivalent, down 65 thousand pounds since last month. Active spot and near-term **uranium demand** totals **940 thousand** pounds, down 455 thousand pounds. The spot and near-term **supply-demand ratio** rose to **2.8:1.**
Transaction Value **fell to \$14.45**	The **Transaction Value** is **\$14.45** per pound U_3O_8, down \$0.45 since last month. The calculation includes 20 transactions involving a total of 4.6 million pounds U_3O_8 and equivalent UF_6, and covers a period of 3 months.
Loan Use Charge Rate **unchanged at 5%**	The **Loan Use Charge Rate** is **5 percent** per annum, unchanged.
Conversion Value **unchanged at \$1.50**	The **Conversion Value** is **\$1.50** per pound U as UF_6, unchanged since last month. Active secondary market supply for conversion services for delivery within three years totals 1.6 million pounds U as UF_6. Active demand totals 965 thousand pounds U as UF_6.
SWU Values: **\$90 for DOE-origin for delivery by the end of FY86** **\$80 for non-DOE origin calendar year 1985** **\$85 for calendar year 1986**	The **SWU Values** for DOE origin at .3 tails and certifiable as excess, are **\$90** per SWU for delivery before the end of FY86. SWU Values for other SWUS (non-DOE or non-certifiable) are **\$80** per SWU for calendar year 1985 delivery, and **\$85** per SWU for calendar year 1986 delivery. Two secondary market SWU transactions are reported, involving 500 thousand SWUs of DOE and Eurodif origin.
Focus	The nuclear fuel market in the Federal Republic of Germany consists of an intricate ownership framework that encompasses utility operations, worldwide uranium production ventures, and all aspects of the fuel cycle.
Canada	Maritime Nuclear's plans for the Point Lepreau Unit 2 have been deferred because of declining electricity demand and the company's inability to attract the interest of New England utilities in the USA.
United States	It is likely that seven nuclear units in the USA will have entered commercial operation in the first half of 1985, one of the first signs of recovery the industry will witness since 1979.
Raw Materials	A wide variety of characteristics are found in the uranium mines of the USSR. Co-product and by-product mining operations are used at many of the production centers, and alternate recovery methods have been exploited successfully.

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NUEXCO REPORT 202 FIGURES OF THE MONTH (May 31, 1985)	This Month (Report 202)	Last Month (Report 201)	12 Months Ago (Report 190)
Exchange Value[1]	15.00	14.25	17.75
Transaction Value[1]	14.45	14.90	17.00
UF_6 Value[2]	42.50	40.50	—
Loan Use Charge Rate[3]	5%	5%	6%
Conversion Value[4]	1.50	1.50	0.80
Near-Term Uranium Supply[5]	2.7	2.7	5.2
Near-Term Uranium Demand[6]	0.94	1.4	2.4
Near-Term Supply-Demand Ratio	2.8	2.0	2.2
Recent Uranium Sales:			
Number of Transactions[7]	8	5	9
Quantity of Material[8]	3.5	1.7	3.5
Nuexco SWU Values:[9]			
DOE origin, certifiable as excess, 0.3 tails assay; delivery before the end of FY86	90	95	—
Other SWUs (non-DOE or non-certifiable)			
1985 delivery	80	80	80
1986 delivery	85	85	—
USDOE SWU Prices:			
USEC	135.00	135.00	135.00
AFC	153.00[10]	153.00[10]	153.00[10]
Requirements	157.00[10]	157.00[10]	157.00[10]
Market Value of Enriched UF_6[11] [12]			
2.5 w/o U_{235}	456	458	556
3.0 w/o U_{235}	587	592	716
3.5 w/o U_{235}	721	728	879
4.0 w/o U_{235}	857	866	1,045

---

[1] US $ per pound U_3O_8 equivalent.

[2] US $ per kilogram UF_6.

[3] Per annum.

[4] US $ per pound U as UF_6.

[5] Active inquiries to sell, for delivery within 12 months after contract signing (millions of pounds U_3O_8).

[6] Active inquiries to purchase, for delivery within 12 months after contract signing (millions of pounds U_3O_8).

[7] Uranium sales only; does not include loans, conversion, or SWU transactions.

[8] Millions of pounds U_3O_8, equivalent.

[9] US $ per SWU.

[10] Effective 10/1/84.

[11] Calculated using the Nuexco Exchange Value, Conversion Value, and 0.30 percent tails assay. From 3/30/84 through 4/29/85, calculations used the Nuexco SWU Value for DOE origin and FY85 delivery. As of 4/30/85, calculations use the Nuexco SWU Value for DOE origin and delivery by the end of FY86.

[12] US $ per KgU as UF_6, rounded to the nearest $.

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JULY 1985 NUMBER 203

MONTHLY REPORT

ON THE NUCLEAR FUEL MARKET

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NUEXCO

MONTHLY REPORT ON THE NUCLEAR FUEL MARKET

July 1985 No. 203

R. WESLEY MILLER, *EDITOR* CLARK M. BEYER, *ASSOCIATE EDITOR*

PRICING

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To Our Readers

We are pleased to announce that **Bob Alexander, Katie Bowen,** and **Earl Hoellen** have been elected vice presidents of Nuexco.

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PRICING

NATURAL URANIUM AND SECONDARY MARKET CONVERSION

The **Exchange Value** as of June 30, 1985, is **$15.00** per pound U_3O_8, unchanged since last month. **Active supply** of natural uranium (U_3O_8 and UF_6) for spot or near-term delivery totals **3,520,000** pounds equivalent U_3O_8 as concentrates or UF_6, up 865,000 pounds since last month. The corresponding figure for **active demand** is **1,325,000** pounds, up 385,000 pounds. The spot and near-term **supply-demand ratio** fell to **2.7:1.**

The *Current Market Data* section of this Report lists eight natural uranium sales transactions, involving a total of approximately 1,500,000 pounds U_3O_8 equivalent. All of the transactions reported this month involved deliveries before 1986, and seven met the criteria for inclusion in the current Transaction Value calculation.

The **UF_6 Value** as of June 30, 1985 is **$42.50** per kilogram U as UF_6, unchanged since last month. Three of the transactions reported this month involved UF_6.

The **Transaction Value** as of June 30, 1985 is **$14.60** per pound U_3O_8, up $0.15 since last month. The current Transaction Value includes 17 transactions involving a total of 4.6 million pounds U_3O_8 or equivalent UF_6 and covers a period of 3 months.

The Loan Use Charge Rate as of June 30, 1985 is unchanged at **5 percent** per annum, as lenders continued to offer substantial quantities of material at that rate.

* * *

The Exchange Value remained at $15.00 this month as material available at prices below that level ostensibly was cleared from the market. One US utility sold its remaining inventory to trading firms during the month at prices at or near the current Exchange Value. The trading firms then reoffered the material to end users during the month. It appears that the end users eventually paid prices near the current Exchange Value for that large amount of inventory material. At the end of the month, market activity diminished, prices stabilized, and the gap between sellers' offers and buyers' bids widened somewhat. As a result, discretionary buyers and sellers now dominate the market. Sellers without immediate need to dispose of material currently are holding out for higher prices. However, the lack of both firm demand and buyers willing to pay above $15.00 precludes a rise in the Exchange Value until fundamental conditions change.

Traders, apparently believing the market has reached a bottom, have been active and aggressive participants in the market, often appearing as the first and most competitive buyers when inventory becomes available for sale. This phenomenon has been evident on a number of occasions in the past few months, and the thin, highly discretionary demand situation has, in several instances, resulted in material passing through several parties before reaching the end user. The appearance of merely one firm buyer elicits the vigorous competition among sellers that is typical of buyers' markets in general. In addition, however, the increasing activities of trading firms are responsible for amplifying the price effects of each instance of firm demand. Whenever such an opportunity presents itself, trading firms concentrate on filling the demand, often offering to buy elsewhere to service that opportunity. Thus, a single, widely known instance of firm demand for a relatively large quantity can, through the amplifying effect of traders, give other market participants the impression that demand is several times greater than it actually is.

There are few *fundamental* differences between the present market situation and that which has existed throughout 1984 and early 1985. There is very little near-term hard demand (i.e., demand for uranium needed now to run reactors), and what demand there is can be classified as soft demand (i.e., buying by trading firms gambling on the firming up of prices, or discretionary buying by end users who are taking advantage of current low prices to partially satisfy future demand). A price recovery is difficult in such circumstances because soft demand will not aggressively follow prices up. Normally, this will only occur when demand strengthens. However, there is so little hard demand in the near-term market that it is difficult to conceive of aggressive buyers bidding up prices. As in the past, a recovery initially will be based upon buyer and seller *perceptions* of a stronger market before actual changes in supply and demand take effect. A similar recovery in 1983 continued for a year before losing momentum and deteriorating in the face of oversupply, decreased demand due to plant cancellations, and the implementation of the US enrichment contract.

* * *

The UF_6 Value remained at $42.50, primarily due to the general lack of demand in the present market. The active supply of UF_6 is greater now than in recent months, and thus the value of UF_6 is slightly less than the sum of the Exchange and Conversion Values.

* * *

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The **Conversion Value** is **$1.60** per pound U as UF_6, up $0.10 since last month as the leading seller of secondary market conversion services vacated the market. One secondary market conversion transaction is reported. Active supply of secondary market conversion services for delivery within three years totals 1.7 million pounds U as UF_6. Active secondary market demand for conversion amounts to 365,000 pounds U as UF_6.

The secondary market for conversion services remains marginally active, with transaction prices stabilized slightly above the $1.50 level. With one supplier out of the market and demand at a minimum, little activity is expected in the coming weeks.

ENRICHED URANIUM AND SWUS

The Nuexco **SWU Values** as of June 30, 1985 are:

1. For **DOE origin,** a tails assay of 0.30 weight-percent U_{235}, for delivery by the end of FY86, and certifiable as excess, $88 per SWU, down $2.
2. For **other** SWUs (includes DOE origin SWUs not certifiable as excess and non-DOE origin SWUs), for delivery by the end of calendar year 1986, $83 per SWU.

One secondary market SWU transaction is reported, involving 100 to 300 thousand SWUs.

* * *

Activity in the markets for SWU of either DOE-certifiable or other origin fell to a minimum in June following the completion of one transaction. Because it was the first firm buyer of a large quantity in some time, fierce seller competition preceded the sale. The buyer was able to obtain a very low price due to the seller competition and complete lack of any other demand.

Sellers of DOE-certifiable SWUs continue to look for opportunities for FY86 SWU, but active demand for either FY85 or FY86 SWUs is limited. As in the past few months, buyers with FY86 requirements are evaluating purchasing strategies and are not compelled to act immediately. Most utilities have filled their requirements, so the FY86 buyers have controlled the market by their emergence for occasional purchases, a situation which has driven down the prices. Nuexco expects sporadic demand to continue for the rest of the year.

The market for other SWUs remained dormant throughout the month. As in the DOE-certifiable SWU market, lack of demand hinders activity and facilitates lower prices when a firm buyer appears. Very little demand is expected in the near term, although some negotiations for 1986 deliveries are continuing.

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CURRENT MARKET DATA

June 30, 1985	Market Values	Active Supply[1] (thousands)	Active Demand[1] (thousands)
EXCHANGE VALUE	**$15.00**/lb. U_3O_8	3,520	1,325
UF_6 VALUE	**$42.50**/kgU		
CONVERSION VALUE	**$1.60**/lb. U as UF_6	1,660	365
SWU VALUES			
DOE origin, certifiable as excess, 0.3 tails assay delivery by the end of FY86	**$88**/SWU		
Other SWUs (non-DOE or non-certifiable) delivery by the end of calendar year 1986	**$83**/SWU		
LOAN USE CHARGE RATE	5%/annum	0	300

TRANSACTION VALUE

$/lb. U_3O_8	Millions of Pounds	Number of Transactions	Number of Months
14.60	4.6	17	3

DEFINITIONS

1. The **Exchange Value** is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the date indicated.
2. The **UF_6 Value** is Nuexco's judgment of the price at which spot and near-term transactions for significant quantities of natural uranium hexafluoride could be concluded as of the date indicated.
3. The **Conversion Value** is Nuexco's judgment of the price at which spot and near-term transactions for significant quantities of conversion services could be concluded in the secondary market as of the date indicated.
4. The **SWU Values** represent Nuexco's judgment of the price at which transactions for the sale of significant quantities of SWUs of stated origin for delivery in the specified time period could be concluded as of the date indicated.
5. The **Loan Use Charge Rate** is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the date indicated.
6. The **Transaction Value** is a weighted average price of recent natural uranium sales transactions. The calculation is based on prices paid in:
   a. Transactions closed within the previous three-month period for which delivery is scheduled within one year of the transaction date;
   b. At least ten transactions;
   c. Transactions involving a sum total of at least 2 million pounds U_3O_8 equivalent.

   The sample time is extended as necessary to include these minima. Other currencies are converted to US dollars using conversion rates in effect on or near the transaction date.

DERIVATIONS AND COMMENTS

1. All Market Values are based on:
   a. Data from recently completed transactions.
   b. Data from pending transactions.
   c. Firm bids to buy or borrow, and firm offers to sell or lend.
   d. Prices purchasers or rates borrowers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy or borrow, and prices sellers or rates lenders have expressed a willingness to offer, but for which Nuexco is not aware of firm offers to sell or lend.
2. Prices associated with deliveries under old or renegotiated contracts or other than arm's-length transactions are not considered in the determination of these Market Values.
3. In the determination of the Conversion Value, Nuexco does not consider transportation charges other than those customarily provided by primary suppliers of conversion services.
4. The prices of conversion services or SWUs delivered under long-term contracts with primary suppliers are not considered in the determination of either the Conversion Value or SWU Value.
5. For the DOE SWU Values, Nuexco converts SWU prices at varying tails and product assays to equivalent SWU prices at a tails assay of 0.30 weight-percent U_{235} and a product assay of 3.0 weight-percent U_{235}, assuming feed costs corresponding to the Nuexco Exchange and Conversion Values determined as of the same date.
6. In calculating the Transaction Value, Nuexco does not account for the price of uranium delivered in connection with contracts which call for "market price" mechanisms. This exclusion applies particularly to contracts in which delivery prices are expressed as a function of future Exchange Values or any other indeterminant variable. Also excluded from the calculation are any other transactions in which the delivery price is defined in such a way that it cannot currently be determined.

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[1] Supply and demand tables in the *Current Market Data* section of this Report detail the numbers for each category.

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CURRENT MARKET DATA

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

	per lb. U_3O_8 in Concentrates			per kg. U in Concentrates		
Country (currency)	This Month (June 30, 1985)	Last Month (May 31, 1985)	12 Months Ago (June 30, 1984)	This Month (June 30, 1985)	Last Month (May 31, 1985)	12 Months Ago (June 30, 1984)
Australia (dollar)	22.50	22.56	20.21	58.49	58.64	52.55
Belgium (comm. franc)	921.94	931.68	992.06	2,396	2,422	2,579
Canada (dollar)	20.45	20.64	23.03	53.16	53.67	59.87
Finland (markka)	95.12	95.97	103.24	247.28	249.50	268.41
France (franc)	139.41	140.98	149.57	362.42	366.51	388.86
FRG (mark)	45.76	46.30	48.71	118.96	120.36	126.62
Italy (lira)	29,222	29,492	30,027	75,972	76,674	78,065
Japan (yen)	3,732	3,773	4,152	9,703	9,810	10,794
Netherlands (guilder)	51.69	52.16	54.88	134.38	135.59	142.67
South Africa (rand)	29.50	29.97	23.68	76.69	77.92	61.56
Spain (peseta)	2,619	2,612	2,766	6,810	6,792	7,191
Sweden (krona)	132.04	133.45	143.09	343.28	346.95	372.00
Switzerland (franc)	38.34	39.00	40.75	99.68	101.40	105.93
UK (pound)	11.58	11.77	12.94	30.11	30.61	33.65
US (dollar)	15.00	15.00	17.50	39.00	39.00	45.50

TRANSACTION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

	per lb. U_3O_8 in Concentrates			per kg. U in Concentrates		
Country (currency)	This Month (June 30, 1985)	Last Month (May 31, 1985)	12 Months Ago (June 30, 1984)	This Month (June 30, 1985)	Last Month (May 31, 1985)	12 Months Ago (June 30, 1984)
Australia (dollar)	21.90	21.73	19.06	56.93	56.49	49.55
Belgium (comm. franc)	897.36	897.52	935.37	2,332	2,333	2,432
Canada (dollar)	19.90	19.89	21.71	51.74	51.70	56.45
Finland (markka)	92.58	92.45	97.35	240.69	240.35	253.08
France (franc)	135.69	135.81	141.03	352.76	353.07	366.64
FRG (mark)	44.54	44.60	45.92	115.79	115.95	119.39
Italy (lira)	28,443	28,411	28,312	73,946	73,863	73,604
Japan (yen)	3,632	3,635	3,915	9,444	9,450	10,177
Netherlands (guilder)	50.31	50.24	51.74	130.80	130.62	134.51
South Africa (rand)	28.71	28.87	22.33	74.64	75.06	58.05
Spain (peseta)	2,549	2,516	2,608	6,628	6,543	6,780
Sweden (krona)	128.52	128.56	134.91	334.13	334.22	350.75
Switzerland (franc)	37.32	37.57	38.42	97.03	97.68	99.88
UK (pound)	11.27	11.34	12.20	29.31	29.49	31.73
US (dollar)	14.60	14.45	16.50	37.96	37.57	42.90

[1] Calculated using currency exchange rates published in the *Wall Street Journal* on June 28, 1985.

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CONVERSION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

	per lb. U as UF_6			per kg. U as UF_6		
Country (currency)	**This Month (June 30, 1985)**	**Last Month (May 31, 1985)**	**12 Months Ago (June 30, 1984)**	**This Month (June 30, 1985)**	**Last Month (May 31, 1985)**	**12 Months Ago (June 30, 1984)**
Australia (dollar)	2.40	2.26	0.00	5.29	4.97	0.00
Belgium (comm. franc)	98.34	93.17	0.00	216.80	205.40	0.00
Canada (dollar)	2.18	2.06	0.00	4.81	4.55	0.00
Finland (markka)	10.15	9.60	0.00	22.37	21.16	0.00
France (franc)	14.87	14.10	0.00	32.78	31.08	0.00
FRG (mark)	4.88	4.63	0.00	10.76	10.21	0.00
Italy (lira)	3,117	2,949	0.00	6,871	6,502	0.00
Japan (yen)	398.11	377.36	0.00	877.68	831.93	0.00
Netherlands (guilder)	5.51	5.22	0.00	12.16	11.50	0.00
South Africa (rand)	3.15	3.00	0.00	6.94	6.61	0.00
Spain (peseta)	279.43	261.28	0.00	616.03	576.02	0.00
Sweden (krona)	14.08	13.35	0.00	31.05	29.42	0.00
Switzerland (franc)	4.09	3.90	0.00	9.02	8.60	0.00
UK (pound)	1.24	1.18	0.00	2.72	2.60	0.00
US (dollar)	1.60	1.50	0.00	3.53	3.31	0.00

SWU VALUES AND UF_6 VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	**DOE SWU Delivery by the End of FY86 (June 30, 1985)**	**Non-DOE SWU Delivery by the End of CY86 (June 30, 1985)**	**UF_6 Value per kg. U in UF_6 This Month (June 30, 1985)**	**UF_6 Value per kg. U in UF_6 Last Month (May 31, 1985)**
Australia (dollar)	131.99	124.49	63.75	63.91
Belgium (comm. franc)	5,408	5,101	2,612	2,639
Canada (dollar)	119.96	113.14	57.93	58.49
Finland (markka)	558.02	526.32	269.50	271.91
France (franc)	817.84	771.38	394.98	399.44
FRG (mark)	268.46	253.20	129.65	131.17
Italy (lira)	171,439	161,698	82,797	83,562
Japan (yen)	21,895	20,651	10,574	10,691
Netherlands (guilder)	303.24	286.01	146.45	147.77
South Africa (rand)	173.06	163.23	83.58	84.92
Spain (peseta)	15,368	14,495	7,422	7,402
Sweden (krona)	774.65	730.63	374.12	378.11
Switzerland (franc)	224.95	212.17	108.64	110.50
UK (pound)	67.95	64.09	32.82	33.36
US (dollar)	88.00	83.00	42.50	42.50

[1] Calculated using currency exchange rates published in the *Wall Street Journal* on June 28, 1985.

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CURRENT MARKET DATA

RECENT TRANSACTIONS[1]

Uranium Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U_3O_8 equivalent)	Approximate Price as Percent of Current E.V.	Seller	Buyer	Remarks
3490	1985	601-1,000	100	US Utility	Trader	UF_6.
3488	1985	less than 50	100	Non-US Utility	Trader	UF_6.
3487	1985	50-100	104	Trader	European Utility	UF_6.
3486	1985	less than 50	98	Trader	US Utility	
3485	1985	101-300	94	European Entity	Trader	
3483	1985	50-100	99	US Producer	US Utility	
3460	1985	50-100	97	US Producer	US Producer	
3459	1985	101-300	indeterminate	Non-US Producer	US Producer	Market-related price.

Secondary Market Conversion Services

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U equivalent)	Approximate Price as Percent of Current C.V.	Seller	Buyer	Remarks
3455	1985	301-600	100	Trader	US Utility	

Enrichment Services
Secondary Market Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity[2] (thousands of SWUs)	Approximate Price[3] as Percent of Current SWU Value[4]	Seller Group	Buyer Group	SWU Origin	Remarks
3484	1986	101-300	R[5]	US Entity	US Utility	R[5]	

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[1] Transactions listed are not limited to those in which Nuexco was involved, but also include others of which Nuexco is aware.

[2] If tails assay is unknown or unspecified, Nuexco's calculation of SWU quantity assumes 0.30 w/o tails assay.

[3] Price is not normalized to 0.30% tails assay.

[4] Refers to SWU Value that corresponds to SWUs included in transaction. When prices and SWU values are expressed as discounts (e.g., X dollars less than DOE's USEC base price at time of delivery), the percentage refers to the ratio of the *discounts*, not the ratio of the prices.

[5] The notation *R* means that Nuexco either does not know, or that Nuexco has restricted that information to protect client confidentiality.

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URANIUM SUPPLY
(June 30, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Spot or Near-term[2]	Intermediate or Long-term	Remarks
Available for Sale:			
ACTIVE			
2134	50	220 per year	1985-87
2335*	275	—	
2389*	300	—	
2483*	545	—	
2654*	500	500 per year	UF_6
2673*	950	—	UF_6
2705A	200	—	UF_6
2728*	200	—	UF_6
2814*	500	500	UF_6
2625	—	250 per year	1987-89
2680	—	250 per year	1986-92
TOTAL:	3,520		
INACTIVE			
1860*	400	1,500 per year	
2191	125	—	UF_6
2336	250	250 per year	1985-94
2553	300	—	
2297	—	200 per year	1986-89
2670	—	525	1987
TOTAL:	1,075		

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*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 1575, 2263, 2392, 2538, 2538B, 2594.

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CURRENT MARKET DATA

URANIUM DEMAND
(June 30, 1985)

	Delivery Period[1] (Thousands of Pounds U_3O_8)		
Nuexco Project Number	**Spot or Near-term[2]**	**Intermediate or Long-term**	**Remarks**
Inquiries to Purchase:			
ACTIVE			
2590	75	—	U_3O_8 or UF_6
2681*	500	500	
2695*	250	500	UF_6
2750*	500	500	
2217	—	1,000 per year	1989-95
2507	—	600	1987-89
TOTAL:	1,325		
INACTIVE			
2548*	290	—	
2576	20	—	UF_6
2636*	100	—	
2457B	—	650	1987
2586	—	300	1987
2643	—	150 per year	1987 on
2694	—	625	1987; UF_6
TOTAL:	410		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2414, 2699, 2716, 2748, 2751.

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LOAN SUPPLY AND DEMAND
(June 30, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8)		Remarks
	Within 1 Year	Beyond 1 Year	
Available for Loan: **INACTIVE**			
1938	2,000	—	UF_6
2036	500	—	
2469A	800	—	
2483	550	—	
2667	800	—	
TOTAL:	4,650		
Inquiries to Borrow: **ACTIVE**			
2606	300	—	
TOTAL:	300		

*New or revised since last month.

[1] Measured from the date of this Report.

Projects removed since last month: None.

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CURRENT MARKET DATA

CONVERSION SUPPLY AND DEMAND
(June 30, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U as UF_6)		Remarks
	Within 3 Years	Beyond 3 Years	
Available for Sale:			
ACTIVE			
2438*	500	250 per year	1986-87
2511	300	300	1986-90
2677	500	—	
2725	360	—	
TOTAL:	1,660		
Inquiries to Purchase:			
ACTIVE			
2419A	55	—	
2587	35	—	
2596*	—	600	
2617	275	420	1986-91
TOTAL:	365		
INACTIVE			
2529	225	—	
2724	—	375	1989-93
TOTAL:	225		

*New or revised since last month.

[1] Measured from the date of this Report.

Projects removed since last month: 2511.

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SWU SUPPLY AND DEMAND
(June 30, 1985)

	Delivery Period[1] (Thousands of SWUs)		
Nuexco Project Number	**Spot or Near-term[2]**	**Intermediate or Long-term**	**Remarks**
Available for Sale:			
ACTIVE			
2607*	200	—	
2624	100	—	
2705	40	—	
2410A	—	350	
2571	—	55	1987
2684	—	35	
TOTAL:	340		
INACTIVE			
2359*	—	200	
2378	—	120	1988
2652	—	25	1986
TOTAL:	0		
Inquiries to Purchase:			
ACTIVE			
2400	—	150	1987-90
2519	—	30 per year	1987 on
2578*	115	—	
2597	—	30	
TOTAL:	115		
INACTIVE			
2543	25	25	1986
2500	—	170	1988
2512	—	15 per year	1987 on
2595	—	50	1986
2693	—	100 per year	1989-90
2706*	—	30	
TOTAL:	25		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes SWUs deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2164, 2633B, 2658, 2713, 2726.

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FOCUS

BRAZIL

Introduction

Brazil's once-ambitious nuclear power program continues to slow down in the face of funding problems and bureaucratic delays. The largest country in South America (Figure 1), with a population of approximately 125 million and an area of 8.5 million square kilometers, Brazil's energy needs and distribution requirements caused the adoption of a new energy strategy aimed at increased use of nuclear energy as the implementation of hydropower reaches its limitations. In 1985, hydropower generated 85 percent of the country's electricity, a percentage that is expected to decline slightly in the future. A nuclear power development effort which began in the early 1970s led to supply and technology relationships with various reactor manufacturers and fuel cycle companies in the Federal Republic of Germany, France, and the USA. The most extensive relationship, based on a Brazilian-West German accord calling for eight 1,300-MWe reactors supplied by Kraftwerk Union (KWU), will be reevaluated in the coming months. The original completion date for all of the units receded from 1990 to 2000, and even that estimate is optimistic. At present, one reactor is in commercial operation and two are under construction, but construction is proceeding at the slowest possible rate. In addition, while Brazil aspires to self-sufficiency in its fuel cycle program, and currently has planned or begun construction on conversion, enrichment, and fuel fabrication facilities, actual completion schedules are uncertain due to financial difficulties. However, the discovery of significant assured uranium resources in at least five regions has led to rapid development of mine and mill facilities, technology and equipment.

Atomic Energy Structure

The Minister of Mines and Energy, a member of the president's cabinet, is responsible for the country's nuclear energy program. The responsibilities of the nuclear energy sector are divided between two entities under his jurisdiction. Empresas Nucleares Brasileiras SA (Nuclebras) is a holding company responsible for the execution of policy in the nuclear program. It controls all aspects of the nuclear fuel cycle, including industrial development, construction of nuclear power plants and other fuel cycle facilities, and also is involved in uranium mining and processing. Comissao Nacional de Energia Nuclear (CNEN) is a research and regulatory body that is in charge of licensing and safety concerns of all nuclear facilities in Brazil.

Electrobras is the state holding company for all electrical utilities in Brazil and also is controlled by the Minister of Mines and Energy. Its primary purpose includes forecasting the demand and growth of national energy needs and managing non-nuclear energy matters. In the early 1970s, various government agencies performed studies to determine the feasibility and desirability of implementing a nuclear program. As a result, an agreement signed between CNEN and Electrobras led to the order in 1971 of the first nuclear power plant in Brazil.

Nuclear Power Program

An Electrobras subsidiary, Central Electrica de Furnas, was the utility designated to carry out the design and construction of the nation's first nuclear plant. Furnas is responsible for 20 percent of Brazil's electrical power generation and supplies power to more than 45 million people. It operates the Angra plant, located within 100 miles of Rio de Janeiro. Angra Unit 1, a 626-MWe Westinghouse turnkey PWR, began commercial operation in December 1984. Angra Units 2 and 3 are 1,245-MWe PWRs supplied by Kraftwerk Union (KWU); Unit 2 is 62 percent complete and Unit 3, presently in the excavation stage, is one percent complete. Construction of the two units is proceeding slowly, and although Electrobras expects operation in 1990 and 1992, Furnas has not yet announced an expected commercial operation date. Plans for two additional reactors, Iguape Units 1 and 2, were recently canceled. All activities related to the units, which were to be in operation by 1995, have been postponed indefinitely by the federal government. In addition, the government has not chosen sites or utilities for new nuclear plants.

International Cooperation

Nuclebras and various enterprises in the FRG participate in most of the joint ventures for the transfer of technology and equipment to Brazil. The areas of industrial cooperation include:

1. Uranium exploration, mining and processing;
2. Construction of reactors and other nuclear facilities;
3. Uranium enrichment services;
4. The manufacture of fuel elements and reprocessing of irradiated fuels.

Brazil and the FRG formed five jointly-owned Brazilian companies in 1976 to perform various functions of the nuclear engineering program. Nuclebras is the Brazilian

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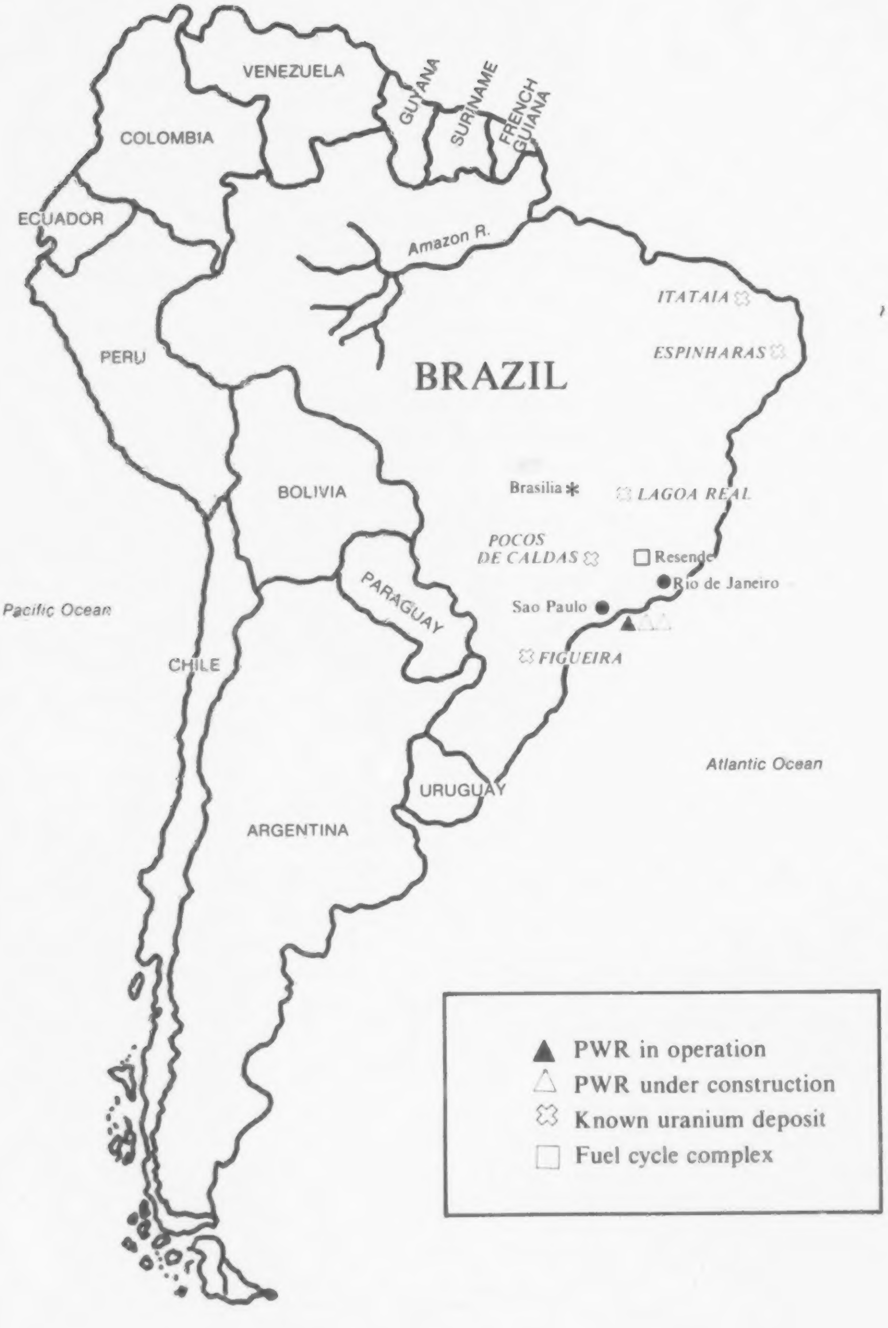
VENEZUELA
GUYANA
SURINAME
FRENCH GUIANA
COLOMBIA
ECUADOR
Amazon R.
ITATAIA
ESPINHARAS
PERU
BRAZIL
BOLIVIA
Brasilia
LAGOA REAL
POCOS DE CALDAS
Resende
Rio de Janeiro
Sao Paulo
PARAGUAY
Pacific Ocean
CHILE
FIGUEIRA
Atlantic Ocean
URUGUAY
ARGENTINA
▲ PWR in operation
△ PWR under construction
Known uranium deposit
☐ Fuel cycle complex

Figure 1: Brazil and South America

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shareholder in all of the companies. Figure 2 illustrates the ownership structure of the following joint companies.

NUCLEN (Nuclebras, 75 percent; KWU, 25 percent) provides project management, technical supervision of plant construction, and other aspects of nuclear power plant engineering.

NUCLEP (Nuclebras, 88.6 percent; KWU, GHH and Voest, 3.8 percent each) handles the construction and factory operation for heavy reactor components. GHH (Gute Hoffnunges Huette AG) is a subsidiary of the large FRG steel company Mannesmann AG, and Voest AG is an Austrian steel company. Both companies build reactor vessels and other heavy components.

NUCLEI (Nuclebras, 75 percent; Steag, 10 percent; Interatom, 15 percent) is conducting the construction and operation of a uranium enrichment plant that will utilize jet-nozzle techniques for isotope separation.

NUSTEP (controlled equally by Nuclebras and Steag) is responsible for developing and licensing the jet-nozzle enrichment process.

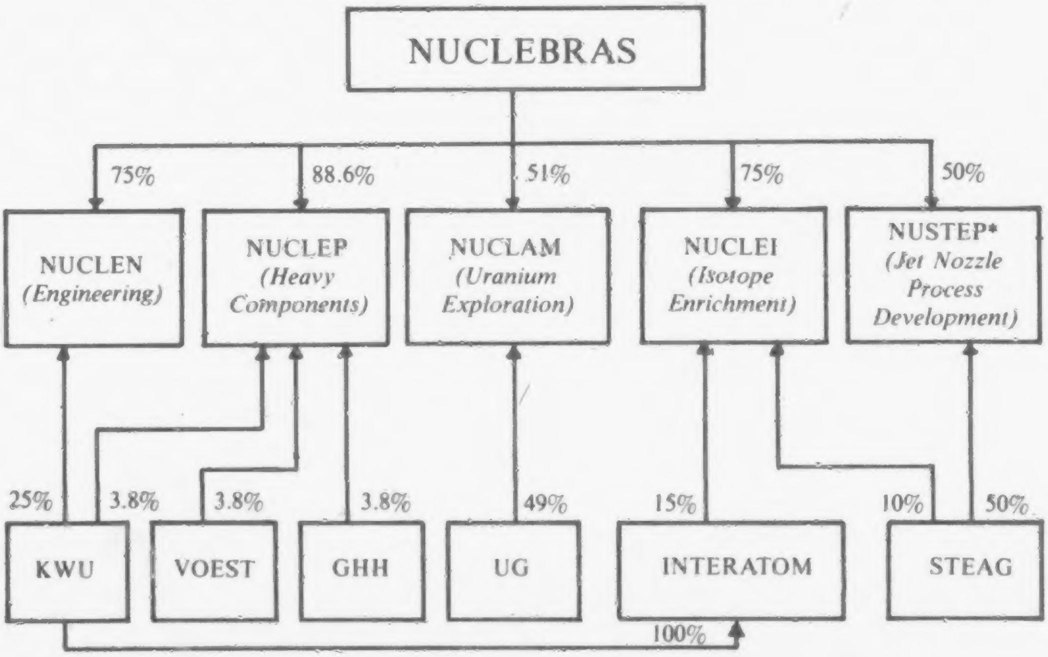
NUCLAM (Nuclebras, 51 percent; Urangesellschaft, 49 percent) is involved in prospecting, exploring and mining of uranium in Brazil.

Uranium Resources

Uranium exploration in Brazil occurred as early as 1952, when Conselho Nacional de Pesquisa and CNEN carried out small-scale explorations. In 1974 the Government established well-defined policies regarding the future development of Brazil's uranium resources. At present, Nuclebras conducts exploration through its NUCLAM subsidiary, often as a joint venture with Urangesellschaft mbH (UG) of the FRG.

Table 1 lists the known uranium deposits in Brazil. The only operating uranium mine and mill is located at the Pocos de Caldas mineral district in southeastern Brazil. Total uranium reserves are estimated at 26,800 tonnes U_3O_8, most of which is located at the Osamu Utsumi mine. The mine life, which in 1982 had been estimated at 40 years assuming an annual production rate of 1,200,000 pounds U_3O_8 per year, recently was reevaluated. Nuclebras now expects mine life to reach ten years with approximately a 900,000 pound U_3O_8 per year production rate. Mill output has declined from 630,000 pounds U_3O_8 in 1982 to 300,000 pounds in 1984, chiefly due to budget cutbacks in production areas. The complex currently is oper-

Figure 2: Joint Brazilian-West German fuel cycle services companies



*Incorporated in the Federal Republic of Germany.

GHH —Gute Hoffnunges Huette AG
KWU —Kraftwerk Union AG
STEAG—Steag AG
VOEST—Voest AG
UG —Urangesellschaft mbH

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ating at less than 50-percent capacity.

At present, federal law prohibits the export of U_3O_8 produced at the Pocos de Caldas facility. The uranium is used for Brazil's commercial reactor program, domestic research purposes, and to repay a uranium loan from neighboring Argentina. The law, which was enacted to protect domestic uranium requirements, also affects any U_3O_8 which may be produced at the Figueira or Amorinopolis deposits. Deposits in other locations, however, are not subject to the site-specific law, and uranium produced there may be exported.

Nuclebras plans to develop at least two other sites containing substantial estimated uranium reserves. The company recently announced its intention to build a 4,400,000 pound U_3O_8 per year mine and mill facility at Lagoa Real in Bahia. Nuclebras will solicit foreign investment, possibly from Japan or the FRG. Over 60,000 tonnes U_3O_8 of reasonably assured reserves are thought to exist at the Lagoa Real deposit. The higher quality of ore there caused Nuclebras to focus attention on plans for Lagoa Real and away from the Itataia deposit. Nuclebras and the French conglomerate Cogema had been negotiating the financing arrangements for a mine and mill complex at the Itataia site, which contains an estimated 91,000 tonnes of reasonably assured reserves, but no agreement was reached in last year's discussions. Should either or both projects be developed, the uranium produced would be available for export.

Other Fuel Cycle Activities

Facilities for conversion, enrichment and fuel fabrication are currently under development in Brazil. Ipen, a federally funded Sao Paulo research institute, began operating in October 1984 a UF_6 conversion pilot plant capable of producing 90 metric tons of UF_6 per year. However, Nuclebras and the French industrial company Pechiney-Ugine-Kuhlmann are designing a larger-scale plant to be located at the Resende fuel cycle complex near Rio de Janeiro.

The first of 24 stages of a uranium enrichment pilot plant utilizing the jet-nozzle process is scheduled to begin operation in 1985. In the jet-nozzle process, UF_6 mixed with a light carrier gas flows through a curved nozzle at high velocity and is split into two streams at the outlet. Heavy and light isotopes are separated during deflection due to centrifugal forces. The first cascade will operate using 24 jet-nozzle separation elements and will enrich uranium to one percent U_{235}. NUCLEI intends to determine the economic viability of the first stage before starting a demonstration unit with a capacity of 64,000 SWU per year in 1988 or 1989. At present, Brazil has some enriched uranium stockpiled through its two-million-SWU contract with Urenco, in anticipation of Angra Units 2 and 3 consumption. In addition, construction of a 100 MTU per year fuel fabrication plant has been completed. Pellet loading, fuel rod welding and bundle assembly processes are in operation. Pellet manufacture and UO_2 reconversion are scheduled to begin operation in 1987 and 1988, respectively.

Table 1
ESTIMATED URANIUM RESERVES IN BRAZIL
(Metric tons of U_3O_8)

	Reserve Category		
Ore Deposit or Mine	**Reasonably Assured[1]**	**Estimated Additional[1]**	**Total**
Pocos de Caldas (Osamu Utsumi)	20,000	6,800	26,800
Lagoa Real Province	61,840	31,350	93,190
Itataia Province	91,200	51,300	142,500
Figueira	7,000	1,000	8,000
Espinharas[2]	5,000	5,000	10,000
Other Deposits	7,500	13,500	21,000
TOTAL	192,540	108,950	301,490

[1] According to IAEA classification.
[2] NUCLAM estimates.

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JAPAN

Nuclear Plant Status

Japan's electric utilities currently are operating 28 nuclear power plants with a net generating capacity of 20,561 MWe (Table 2, Figure 3). An additional 14 units with a total net capacity of 13,858 MWe are under construction. Three of those already have achieved criticality and will enter commercial operation in 1985. The remaining 11 units under construction are scheduled to begin operation between 1986 and 1994. Although some delays may occur, Japan's demonstrated efficiency in nuclear plant construction suggests that the utilities will achieve most of these expected operational dates.

Six additional plants with a total capacity of 6,275 MWe officially have been recognized as projects and are undergoing licensing procedures (see Report 188 for a discussion of nuclear plant licensing in Japan). Commercial operation dates for these projects range from 1991 to 1994. Due to possible licensing problems or reduced utility load growth, it is conceivable that some of these dates may be deferred.

The Ministry of International Trade and Industry (MITI), the government body responsible for long-range planning of electric power generation, in 1984 established a nuclear generation objective of 48,000 MWe by 1995. Without delays, the total nuclear generating capacity of the 48 plants in Table 2 (28 in operation, 14 under construction, and 6 undergoing licensing) that could be operating by 1995 would only represent 40,694 MWe. Recently, however, the private utilities announced their *planned* nuclear plant construction program, consisting of nine additional units as shown in Table 3. Seven of the units are scheduled to begin operation before 1995, and would add 6,865 MWe to the 40,694 MWe in operation, construction or licensing, resulting in a total of 47,559 MWe by 1995. Thus, under the best circumstances the MITI goal could be realized.

Of the nine new plants in Table 3, four are scheduled to receive preliminary approval in 1986, which would permit them to initiate formal licensing procedures. The remaining five are scheduled for similar action in 1987. Hamaoka Unit 4 and Onagawa Unit 2 will be extensions of existing plant sites, and should achieve actual project status with a minimum of delays. The remaining units would be located in areas designated as potential sites by the utilities several years ago, and site negotiations with local interests are continuing. Hokuriku Electric Power Company (EPC) recently completed initial boring of its often-delayed Noto site, but is continuing negotiations with a fisherman's cooperative group strongly opposed to plant construction. Chubu EPC presently is evaluating a study by Japanese nuclear vendors on the economics of selecting BWR versus PWR plant type for its proposed Ashihama site. Nuexco expects some delays on the six projects now undergoing licensing in addition to delays to the recently announced plants listed in Table J. Thus, Nuexco presently forecasts 42,000 MWe in operation in 1995. Assuming a 0.25 percent U_{235} tails assay, the forecast mix of PWRs and BWRs, and likely improvements in fuel burnup, a 42,000 MWe capacity will require approximately 13 million pounds U_3O_8 and four million SWUs annually.

Enrichment

As noted in Report 193, significant progress had been made in the approval process for construction of joint fuel cycle facilities at Rokkasho-Mura in the northern part of Japan's main island of Honshu. The facilities will include enrichment, reprocessing, and low-level waste-storage plants. Subsequently, the local government of Aomori Prefecture, in which the facilities will be located, formally granted approval to the combined projects. This action was followed by detailed cooperative agreements between the Prefectural and Rokkasho village governments, Japan Nuclear Fuel Industries (JNFI) and Japan Nuclear Fuel Services (JNFS). JNFI is a private company established in 1985 by the Japanese utilities and other nuclear industry participants to build and operate the enrichment and waste facilities. JNFS, also a private company, was organized by the utilities in 1980 to own and operate the reprocessing facility. The cooperative agreements committed JNFS and JNFI to assure plant safety, as well as to promote the economic and general welfare of the local community. JNFS and JNFI have established local area offices to execute over the next eighteen months site preparatory work and environmental studies necessary for subsequent plant licensing. Current plans for the facilities include:

1. An enrichment capacity of 150,000 SWU per year by 1991, which will be expanded to 1.5 million SWU per year by 1997;
2. A reprocessing capacity of 800 tons of spent fuel per year by 1995, and a storage capacity of 3,000 tons of spent fuel to be completed by 1991.

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Table 2

NUCLEAR POWER PLANTS IN JAPAN

Utility	Unit	Capacity (MWe Net)	Type	COD[1]
Chubu EPC[2]	Hamaoka 1	540	BWR	Mar 1976
	Hamaoka 2	840	BWR	Nov 1978
	Hamaoka 3*	1100	BWR	Sep 1987
Chugoku EPC	Shimane 1	460	BWR	Mar 1974
	Shimane 2*	820	BWR	Feb 1989
Hokkaido EPC	Kyowa Tomari 1*	579	PWR	Jun 1989
	Kyowa Tomari 2*	579	PWR	Jun 1991
Japan Atomic Power Company	Tokai 1	166	GCR	Jul 1966
	Tokai 2	1100	BWR	Nov 1978
	Tsuruga 1	357	BWR	Mar 1970
	Tsuruga 2*	1160	PWR	Jun 1987
Kansai EPC	Mihama 1	340	PWR	Nov 1970
	Mihama 2	500	PWR	Jul 1972
	Mihama 3	826	PWR	Dec 1976
	Takahama 1	826	PWR	Nov 1974
	Takahama 2	826	PWR	Nov 1975
	Takahama 3	870	PWR	Jan 1985
	Takahama 4*	870	PWR	Jun 1985
	Ohi 1	1175	PWR	Mar 1979
	Ohi 2	1175	PWR	Dec 1979
	Ohi 3**	1180	PWR	Jul 1991
	Ohi 4**	1180	PWR	May 1992
Kyushu EPC	Genkai 1	559	PWR	Oct 1975
	Genkai 2	559	PWR	Mar 1981
	Genkai 3*	1180	PWR	Mar 1993
	Genkai 4*	1180	PWR	Mar 1994
	Sendai 1	890	PWR	Jul 1984
	Sendai 2*	890	PWR	Jan 1986
Shikoku EPC	Ikata 1	566	PWR	Sep 1977
	Ikata 2	566	PWR	Mar 1982
	Ikata 3**	890	PWR	Mar 1992
Tohoku EPC	Onagawa 1	524	BWR	Jun 1984
	Maki 1**	825	BWR	1995
Tokyo EPC	Fukushima I-1	460	BWR	Mar 1971
	Fukushima I-2	784	BWR	Jul 1974
	Fukushima I-3	784	BWR	Mar 1976
	Fukushima I-4	784	BWR	Oct 1978
	Fukushima I-5	784	BWR	Apr 1978
	Fukushima I-6	1100	BWR	Oct 1979
	Fukushima II-1	1100	BWR	Apr 1982
	Fukushima II-2	1100	BWR	Feb 1984
	Fukushima II-3*	1100	BWR	Jul 1985
	Fukushima II-4*	1100	BWR	Sep 1987
	Kashiwazaki 1*	1100	BWR	Oct 1985
	Kashiwazaki 2*	1100	BWR	Oct 1990
	Kashiwazaki 3**	1100	BWR	Jul 1993
	Kashiwazaki 4**	1100	BWR	Jul 1994
	Kashiwazaki 5*	1100	BWR	Apr 1990
Total In Operation		20,561		
Total Under Construction or Licensing		20,133		
TOTAL		40,694		

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* Unit under construction.

** Unit undergoing licensing procedures.

[1] Actual or expected Commercial Operation Date.

[2] EPC = Electric Power Company.

[3] JAPC = Japan Atomic Power Company.

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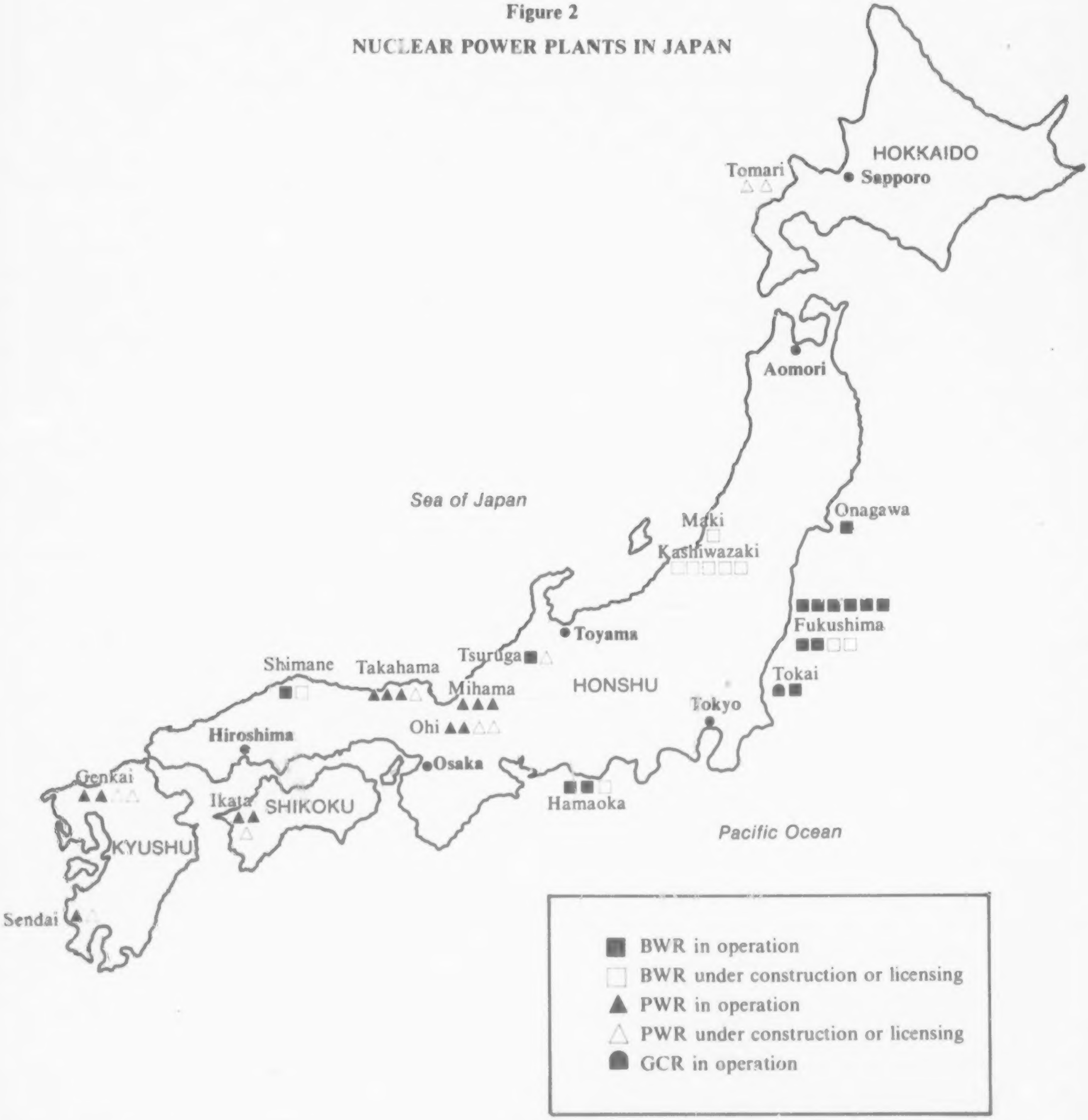
Figure 2

NUCLEAR POWER PLANTS IN JAPAN


HOKKAIDO
Tomari
Sapporo
Aomori
Sea of Japan
Onagawa
Maki
Kashiwazaki
Fukushima
Toyama
Tsuruga
Shimane
Takahama
Mihama
HONSHU
Tokai
Tokyo
Ohi
Hiroshima
Osaka
Genkai
Ikata
SHIKOKU
Hamaoka
Pacific Ocean
KYUSHU
Sendai
■ BWR in operation
□ BWR under construction or licensing
▲ PWR in operation
△ PWR under construction or licensing
● GCR in operation

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Enrichment technology has been developed by the Power Reactor and Nuclear Fuel Development Company (PNC) under government sponsorship as part of a national program for greater self-sufficiency in the nuclear fuel cycle. PNC will utilize gas centrifuge technology. PNC recently announced further technical progress in the form of a new centrifuge design which may be 50 percent more efficient than previous centrifuges, while occupying only 40 percent of the installation space. The new centrifuges will be installed in a 200,000 SWU per year demonstration plant currently under construction on the west side of Honshu and scheduled for completion in 1988. The same new design will also be installed in the first phase of the commercial-scale JNFI facility at Rokkasho-Mura.

The recent decision by the US Department of Energy to abandon the Gas Centrifuge Enrichment Plant (GCEP) program in favor of development laser enrichment technology, combined with Cogema's recent emphasis on laser technology, has raised the issue of laser enrichment potential in Japan. Even prior to the DOE announcement, some concerns had been expressed that Japanese nuclear industry should more carefully monitor the possible application of laser enrichment technology. Under government sponsorship, a study team was dispatched to Europe in March to review laser technology status. The visit was followed by a seminar in Japan in May, sponsored by the French government, to promote French laser technology to government and nuclear industry personnel. In June, the Japanese government also sponsored a visit to the USA by a team of specialists. Although laser technology had achieved little emphasis in Japan, it is likely that recent US and European events will alter somewhat Japan's current enrichment program. Considering the advances in domestic centrifuge technology, it is certain that JNFI's centrifuge plant will proceed as planned. However, at the end of June, the Federation of Electric Power Companies (FEPC), disclosed a decision to introduce the laser process into the second phase of the domestic enrichment program. The first phase will proceed as planned, utilizing the centrifuge process. The second-stage plant tentatively is scheduled to be built in Okayama Prefecture (also on Honshu) and to produce 1.5 million SWU per year by 2004 using the laser process.

In other enrichment developments, Asahi Chemical Company announced the completion of an ion-exchange plant capable of enriching uranium. In a program jointly sponsored by the government Science and Technology Agency (STA), Asahi Chemical has completed the installation of a model plant in Miyazaki Prefecture, on the island of Kyushu, capable of producing 1,000-2,000 SWU per year. Test operation will begin in late 1985, and the equivalent of $60 million has been allocated for the seven-year development program which began in 1984. Two-thirds of the program is sponsored by STA. Asahi Chemical has already produced kilogram quantities of uranium enriched to three percent U_{235}. No technical or economic details of the process have been made public. The an-

Table 3

JAPANESE UTILITIES' PLANNED NUCLEAR UNITS

Unit	Utility	MWe	Type	COD[1]
Onagawa 2	Tohoku EPC[2]	825	BWR	Jul 1994
Higashidori 1	Tohoku EPC	1100	BWR	Oct 1994
Namie-Odaka	Tohoku EPC	825	BWR	After 1996
Hamaoka 4	Chubu EPC	1100	BWR	Jul 1994
Ashihama 1	Chubu EPC	1100	—[3]	Dec 1994
Ashihama 2	Chubu EPC	1100	—[3]	Sep 1995
Noto 1	Hokuriku EPC	540	—[3]	Mar 1993
Hohoku 1	Chugoku EPC	1100	—[3]	Nov 1995
Hohoku 2	Chugoku EPC	1100	—[3]	Nov 1997
	TOTAL	8,790		

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[1] COD = Expected Commercial Operation Date.

[2] EPC = Electric Power Company.

[3] Reactor type not yet defined.

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nouncement emphasized that the process could not produce military-grade enriched product, in accordance with non-proliferation objectives.

In a related action, MITI suggested the Japanese utilities should consider building a facility for conversion of U_3O_8 to uranium hexafluoride (UF_6). The facility should have enough capacity to meet the needs of the new enrichment facility at Rokkasho-Mura. MITI has initiated a two-year study of the economics of a domestic conversion facility, possibly to be located in conjunction with the Rokkasho-Mura enrichment facility. Currently, the Japanese utilities utilize overseas converters for all of their conversion needs. As in other areas of the fuel cycle, it would appear that some degree of domestic conversion capacity will be desired for further nuclear power self-sufficiency.

Natural Uranium Developments

International Resources Corporation (IRC) of Japan recently announced the continuation of its exploration program in Niger. IRC is a company owned jointly by Arabian Oil of Japan, Tokyo EPC, Kansai EPC, Chubu EPC, and several trading and financial groups in Japan. Since 1975, in cooperation with Onarem (Office National des Ressources Miniere) of Niger, IRC has been active in two districts of Niger, located approximately 600 kilometers north of Niamey. In the late 1970s IRC confirmed deposits estimated at 10,000 tons U_3O_8 with ore grades of approximately 0.25-0.3 percent at one of the sites. IRC also has completed preliminary evaluation in one of the districts, which indicated an additional 6,000 tons U_3O_8 with ore grades in the range of 0.5-0.6 percent. Further exploration and subsequent development of the two deposits have been delayed for several years because of uncertain market conditions. In the recent announcement, IRC indicated their intent to resume exploration in one of the districts. Under a four-year contract signed in late 1984, IRC will drill 55 test holes from September 1985 to April 1986. Upon completion of the drilling program, IRC will evaluate the economic feasibility of both deposits. If the evaluation is favorable, development work could start as soon as 1988, with commercial production scheduled for 1993. If realized, the project will have begun production approximately ten years later than the originally scheduled production date. The continuation of the IRC program reflects Japan's continuing commitment to its long-term goal of increasing to 25 percent the share of uranium supply acquired from sources with Japanese participation.

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AUSTRALIA

As expected, Western Mining Corporation and BP Australia, joint venture partners in the Olympic Dam (Roxby Downs) project, have announced that the uranium-copper-gold project is commercially viable. A firm decision to proceed with development will be made before the end of 1985; gold production is scheduled to begin in 1987, and uranium and copper production should begin in mid-1988. The partners anticipate annual production will amount to 2,000 metric tons (tonnes) U_3O_8, 55,000 tonnes of copper, and up to 90,000 ounces of gold. The study indicated that the project was viable at slightly smaller ore tonnages than had been planned. The partners concluded that under current conditions a project of this size is justified, while leaving open the option of progressive expansion of production should market opportunities dictate. A joint company, Olympic Dam Marketing Pty. Ltd., has been established to assist with the marketing of the projected output. Development costs for the project are expected to amount to A$550,000,000 in addition to the A$150,000,000 already spent to date.

The project is one of the largest undeveloped base metal resources, containing copper, gold and uranium, as well as recoverable silver and rare earth oxides. Present plans indicate an initial mine life of 30 years. Economic mineralization occurs at depths ranging from 350 to 650 meters. Conventional underground mining methods will be used. Over 60,000 tonnes of ore already have been treated in the metallurgical pilot plant, and approximately 22,000 pounds U_3O_8 have been produced.

Given the inclinations of the partners and the political and economic situation in South Australia, it was almost certain that Roxby Downs would be deemed viable *in some form.* The project has the strong backing of the State government of South Australia, and Australia's Labor Government has approved the project under its limited uranium development policy. The current weak market conditions for all three commodities probably account for the fact that the announced production rates are lower than those originally proposed. Moreover, because the Australian floor price for uranium is approximately twice the current spot price, the uranium will prove the most difficult commodity to market. Internationally, a number of buyers have elected to fill their needs through the late 1980s and early 1990s by purchasing material on the spot market and holding it in inventory for later use. The US enrichment contract has deferred new feed requirements by allowing the use of existing inventories of enriched product.

An aggressive marketing effort by the Roxby Downs partners could provide impetus to other Australian, Canadian and African producers intent on protecting their market shares. It is likely that buyers will closely watch developments at Roxby Downs, as it will provide increased supply diversity and competition. New, large sources of uranium capture the attention of the market, as Canada's Cigar Lake deposit has shown. In view of the Australian floor price, and limited uranium demand in the pre-1990 period, there appears to be no natural niche for the 4.5 million pounds of U_3O_8 expected from Roxby Downs in its early years of production. However, it is possible that some buyers will be motivated to purchase from this source in smaller quantities to obtain an initial position in this large, long-term supply source.

UNITED STATES

The Department of Energy (DOE) recently chose Atomic Vapor Laser Isotope Separation (AVLIS) over the advanced gas centrifuge as the next US enrichment process. (For a discussion of the AVLIS process, see page 13 of Report 201, May 1985.) To avoid funding research and development of two technologies, DOE will end support for the gas centrifuge enrichment plant (GCEP) currently under construction in Portsmouth, Ohio. In a further cost-reducing measure, the gaseous diffusion plant at Oak Ridge, Tennessee will be placed on standby status.

Energy Secretary John Herrington announced these decisions in early June as part of a revised business strategy to stem the ongoing erosion of DOE's market share, which has declined by approximately 50 percent in recent years. DOE SWU prices are the highest in the market and will remain so even if, as expected, FY86 prices are reduced to $125.00 per SWU from the FY85 price of $135.00 per SWU.

A year-long study conducted by a DOE-appointed Process Evaluation Board provided the basis for the decision to choose AVLIS over the GCEP program, despite the fact that $2.6 billion has been spent on the Portsmouth GCEP project. (1,100 centrifuge machines have been installed, and the planned installation of 24,000 centrifuges was expected to cost an additional $2.4 billion.) The Board found that AVLIS technology has "better potential for low cost and reliable production of separative work units in the future," being less capital-intensive and having a lower estimated SWU cost.

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Furthermore, the Board found that AVLIS has a greater potential for technology improvement which could lead to further cost reductions. Another important advantage of AVLIS stemmed from the conclusion that it could be funded within the financial constraints projected for enrichment, while a continuation of the GCEP would require additional funding. DOE expects to spend $80 million on AVLIS research in FY86, and could be ready to deploy the technology as early as 1989. A 10-million SWU per year plant could enter operation in the mid-1990s.

DOE decided to halt production at the Oak Ridge diffusion plant after extensive financial analyses indicated that $50 million could be saved annually if the plant was put on standby status. The facility could be brought back into operation if the demand for enriched uranium increases, but at present DOE's three diffusion plants are operating at only 40 percent of their combined capacity. High electricity costs at the Oak Ridge plant, due to old power contracts with the Tennessee Valley Authority, and the plant's relatively small capacity contributed to the decision.

At present, it is premature to draw any firm conclusions concerning the impact of AVLIS on future markets for uranium and SWU. However, it is not too early to note that, given certain cost and technical parameters which are conceivable, AVLIS could operate efficiently at tails assays well below 0.2 weight-percent (w/o) U_{235}. Lower tails assays for enrichment, of course, translate into reduced uranium needs and increased SWU needs. Table 4 illustrates these relationships for a typical 1,000-MWe PWR reload. Moreover, it has been reported that AVLIS operates more efficiently with depleted feed than with natural uranium. If true, DOE's stockpile of 0.20-0.30 w/o tails material would emerge as one of the world's largest uranium supplies. If the cost of enriching tails material with AVLIS was as low as $30 per SWU, by 1995 the DOE tails stockpile could yield the equivalent of 200 million pounds U_3O_8 at a cost of less than $20 per pound.

AMPLIFICATIONS

Two points in last month's article on the nuclear fuel market in the Federal Republic of Germany (Report 202, page 15) require amplification.

1. On page 16, Table 2, the governing political party for the country as a whole is a coalition of the Christian Democratic Union (CDU), the Christian Social Union (CSU), and the Free Democratic Party (FDP), not simply the CDU as indicated in the table.
2. On page 20, it is stated that RBW (Rheinisch-Braunkohlenwerke AG) is Germany's largest coal producer. In actuality, RBW is the leading *lignite*, or brown coal, producer in the FRG.

Table 4

CHANGES IN URANIUM AND SWU REQUIREMENTS AT VARYING TAILS ASSAYS[1]

Tails Assay	Natural Uranium Requirements (lbs. U_3O_8)	Change in U_3O_8 Requirements from 0.2 Tails Assay (lbs. U_3O_8)	Percent Change	SWU Requirements	Change in SWU Requirements from 0.2 Tails Assay	Percent Change
0.30	360,000	+61,000	+20	76,000	− 20,000	− 21
0.25	326,000	+27,000	+ 9	85,000	− 11,000	− 12
0.20	**299,000**	**0**	**0**	**96,000**	**0**	**0**
0.15	276,000	−23,000	− 8	110,000	+ 14,000	+ 15
0.10	257,000	−42,000	−14	132,000	+ 36,000	+ 38
0.05	241,000	−58,000	−19	172,000	+ 76,000	+ 79
0.01	230,000	−69,000	−23	274,000	+178,000	+185

[1] Assumes requirements for a typical PWR reload with 3.5-percent enrichment, a 65-percent capacity factor, and a 12-month cycle.

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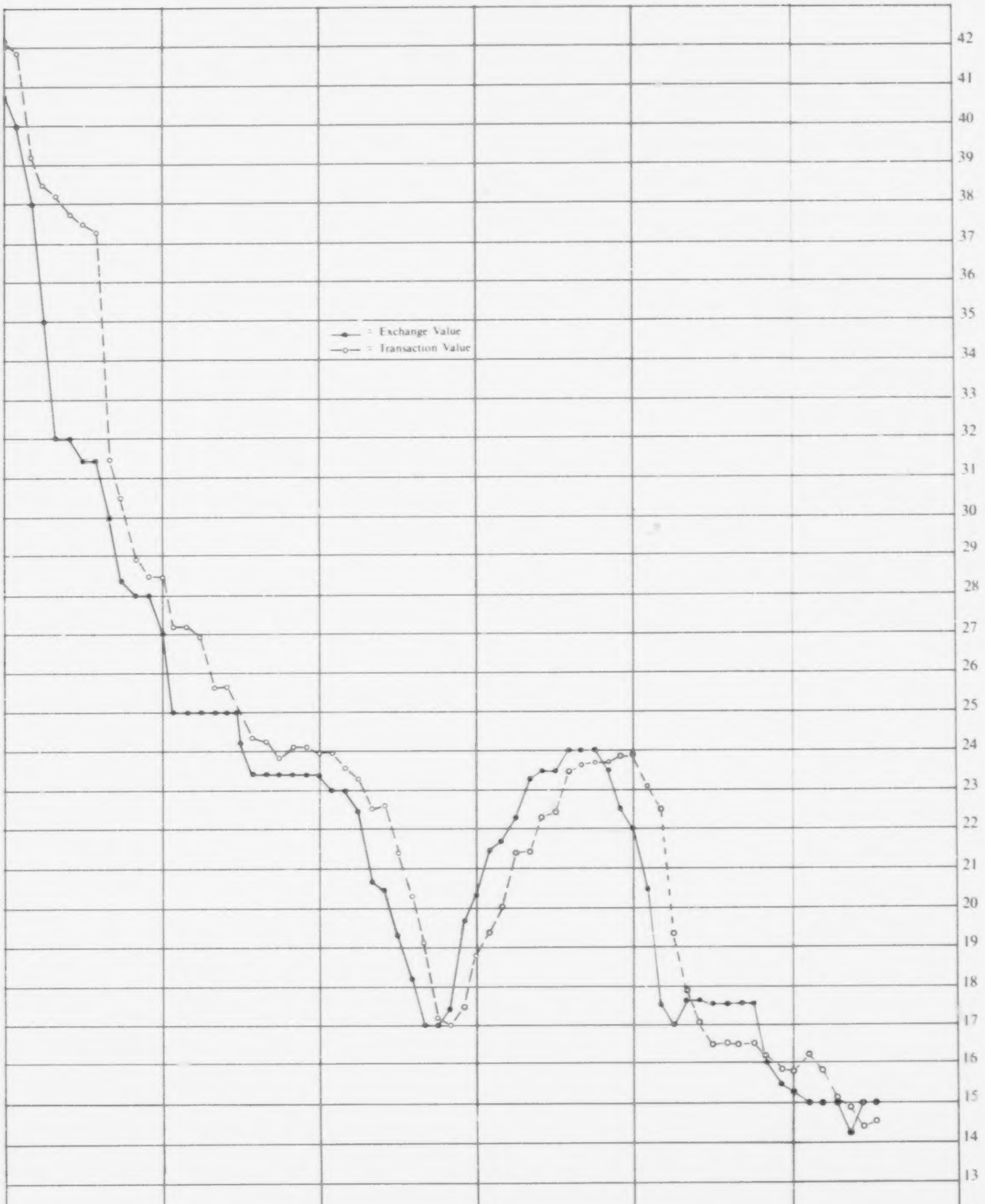
HISTORICAL MARKET DATA

EXCHANGE AND TRANSACTION VALUES SINCE JANUARY 1980

Determined as of the last day of the month indicated



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HISTORICAL MARKET DATA

HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	—	—	—	—	—	—	—	6.35	6.35	6.40	6.45	6.50
1969	—	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	32.50	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00
1981	25.00	25.00	25.00	25.00	25.00	24.25	23.50	23.50	23.50	23.50	23.50	23.50
1982	23.00	23.00	22.50	20.75	20.50	19.25	18.25	17.00	17.00	17.50	19.75	20.25
1983	21.50	21.75	22.25	23.25	23.50	23.50	24.00	24.00	24.00	23.50	22.50	22.00
1984	20.50	17.50	17.00	17.75	17.75	17.50	17.50	17.50	17.50	16.00	15.50	15.25
1985	15.00	15.00	15.00	14.25	15.00	**15.00**						

HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	—	—	—	—	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38.40	37.90	37.60	37.30	31.60	30.60	29.00	28.70	27.70
1981	27.20	27.20	27.00	25.70	25.70	24.50	24.40	24.30	23.90	24.10	24.10	24.00
1982	24.00	23.70	23.40	22.60	22.70	21.50	20.30	19.10	17.30	17.00	17.55	18.80
1983	19.35	20.00	21.35	21.40	22.35	22.45	23.50	23.60	23.65	23.65	23.85	23.85
1984	23.05	22.50	19.25	17.90	17.00	16.50	16.60	16.40	16.55	16.05	15.90	15.90
1985	16.20	15.70	15.05	14.90	14.45	**14.60**						

HISTORICAL CONVERSION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U as UF_6)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	1.20	1.20	1.20	1.40	1.15	1.15	1.15	1.10	1.10	1.10	1.20	1.20
1982	1.20	1.20	1.20	1.20	1.00	1.00	1.00	0.90	1.10	1.60	1.45	1.45
1983	1.20	1.40	1.40	1.20	1.20	1.20	1.10	1.10	1.00	0.60	0.60	0.60
1984	0.60	0.30	0.80	0.80	0.80	0.00	0.00	0.80	1.00	1.00	0.80	0.80
1985	1.00	1.00	1.00	1.50	1.50	**1.60**						

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AUSTRALIA

	Price Index of Materials Used in Manufacturing Industry—All Groups[1] (1969=100)	Award Rates of Pay Indexes Australia—Adult Males In Mining Wage and Salary Earners, Weekly Rates[2] (1976=100)
1983 Avg.	401.2	181.8
Jan 1984	399.2	188.6
Feb 1984	402.5	188.5
Mar 1984	403.9	188.3
Apr 1984	404.2	196.2
May 1984	403.8	197.0
Jun 1984	404.9	197.4R
Jul 1984	408.5	197.4R
Aug 1984	413.3	197.4R
Sep 1984	412.1	197.4R
Oct 1984	408.6	197.4R
Nov 1984	407.3	197.4R
Dec 1984	406.0	197.4R
Jan. 1985	409.4	197.4R
Feb 1985	416.0R	197.4R
Mar 1985	426.7R	197.4R
Apr 1985	—	202.3

P = Preliminary R = Revised since last month

CANADA

	Industry Selling Price Index: Manufacturing[1] (1971=100)	Wage-earner Data: Average Hourly Earnings (C$)[2]					
		Uranium Mines (SIC 057)	Metal Mines* (SIC 051-059)	Mines, Quarries and Oil Wells[3] (SIC 051-099)	Primary Metal Industries Non-ferrous[4] (SIC 296)	(SIC 298)	Chemicals and Chemical Products[5] (SIC 372-379)
1983 Avg.	298.8	—	—**	14.30	—	—	11.17
May 1984	310.6	18.48	15.64	15.06	12.11	10.16	11.65
Jun 1984	311.0	18.08	15.48	14.80	12.38	10.40	11.66
Jul 1984	312.7	17.81	15.72	14.92	12.53	10.18	11.82
Aug 1984	312.7	17.24	15.36	14.92	12.44	10.34	11.78
Sep 1984	312.3	17.68	15.96	15.34	12.51	10.52	11.90
Oct 1984	312.3	17.64	16.15	15.26	12.69	10.56	11.96
Nov 1984	313.6	18.04	16.13	15.43	12.47	10.51	11.96
Dec 1984	314.2	17.95	16.39	15.60	12.16	10.40	11.99
Jan 1985	315.8	18.05	16.13	15.60	12.32	10.80	12.04
Feb 1985	316.4	18.78	16.41	15.68	12.52	11.05	12.06
Mar 1985	317.5	18.24	16.21R	15.43R	12.43R	10.97R	12.02R
Apr 1985		18.63P	16.39P	15.74P	12.77P	11.21P	12.06P

P = Preliminary R = Revised since last month

For annual averages prior to 1983, and for notes pertaining to these statistics, see pages 23-26 of Report 190 of June 1984.

*The 1980 average for Metal Mines was incorrectly reported as 10.59. The correct average is 10.58 (see Report 190).

**Two different methods were used in the 1983 "Metal Mines" category in reporting survey data, and Statistics Canada did not publish a 1983 average. The March 1983 figure for the old method was 14.73 and for the new method was 14.84. The published average for 1983 in Report 190 was a Nuexco calculation based on the available monthly statistics for 1983 with the exception of the March figure, where only the 14.84 value was taken into account.

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GOVERNMENT STATISTICS

UNITED STATES

	Producer Price Index[1]		Consumer Price Index[2] (1967=100)	GNP Implicit Price Deflator[3] (1972=100)	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[4]			
	Industrial Commodities (1967=100)	All Commodities (1967=100)			Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)	Electric and Electronic Equipment (SIC 36)
1983 Avg.	315.8	303.1	298.4	215.63	12.57	13.43	10.59	8.65
May 1984	323.3	311.7	309.7	—	12.99	13.37	11.02	8.89
Jun 1984	323.9	311.4	310.7	222.40	12.96	13.40	11.03	8.91
Jul 1984	324.0	312.0	311.7	—	13.02	13.36	11.12	8.95
Aug 1984	323.5	310.9	313.0	—	13.10	13.51	11.13	9.00
Sep 1984	322.3	309.5	314.5	224.57	13.20	13.39	11.23	9.08
Oct 1984	323.2	309.4	315.3	—	13.23	13.53	11.32	9.09
Nov 1984	323.8	310.4	315.3	—	13.23	13.76	11.35	9.15
Dec 1984	323.0	309.9	315.5	226.10	13.28	13.66	11.37	9.27
Jan 1985	322.9R	309.5R	316.1	—	13.29R	13.70R	11.39R	9.33R
Feb 1985	322.5	309.2	317.4	—	13.30R	13.73R	11.39R	9.33R
Mar 1985	322.6	308.7	318.8	229.01	13.29R	13.95R	11.37R	9.39R
Apr 1985	323.8	309.3	320.1	—	13.47P	13.56P	11.47R	9.39R
May 1985	325.3	309.9	321.3	—	—	—	11.45P	9.42P

P = Preliminary R = Revised since last month

For annual averages prior to 1983, and for notes pertaining to these statistics, see pages 23-26 of Report 190 of June 1984.

REPUBLIC OF SOUTH AFRICA

	Average Declared Working Costs per per Metric Ton of Gold Ore Milled (Rand)[1]	Tonnage-Weighted Index of Average Working Costs per Metric Ton of Gold Ore Milled (March 1982=100)[2]	Consumer Price Index[3] (1975=100)[4]	Producer Price Index All Groups[5] (1975=100)	Total Employment in Mining and Quarrying (Code 35)[6]	Total Salaries and Wages in Mining and Quarrying (1,000 Rand) (Code 40)[6]
1983 Avg.	51.87	115.0	262.2	274.8	696,579	3,644,772
Jan 1984	—	—	274.7	283.3	689,807	326,619
Feb 1984	—	—	278.4	286.5	702,553	335,906
Mar 1984	55.30	123.1	281.9	288.0	715,628	342,332
Apr 1984	—	—	286.1	290.2	712,963	327,550
May 1984	—	—	288.3	292.6	710,040	327,937
Jun 1984	56.95	126.2	291.2	295.3	717,009	347,121
Jul 1984	—	—	295.1	296.0	717,121	369,964
Aug 1984	—	—	297.0	300.8	721,905	361,357
Sep 1984	60.64	133.2	299.9	304.1	721,470	359,218
Oct 1984	—	—	303.7	308.7	717,865	363,755
Nov 1984	—	—	307.4	312.8	717,396	369,771
Dec 1984	62.92	138.6	309.4	315.9	701,198	365,234
Jan 1985	—	—	177.1*	166.6*	711,366	376,777
Feb 1985	—	—	182.8*	171.3*	—	—
Mar 1985	64.48	142.4	183.6*	173.0*	—	—
Apr 1985	—	—	187.4*	174.0*	—	—
May 1985	—	—	189.5*	—	—	—

*The basis for calculation for these indices has been revised to January 1980 = 100.

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NUEXCO REPORT 203 FIGURES OF THE MONTH (June 30, 1985)	This Month (Report 203)	Last Month (Report 202)	12 Months Ago (Report 191)
Exchange Value[1]	15.00	15.00	17.50
Transaction Value[1]	14.60	14.45	16.50
UF_6 Value[2]	42.50	42.50	—
Loan Use Charge Rate[3]	5%	5%	6%
Conversion Value[4]	1.60	1.50	0.00
Near-Term Uranium Supply[5]	3.5	2.7	4.3
Near-Term Uranium Demand[6]	1.3	0.94	1.9
Near-Term Supply-Demand Ratio	2.7	2.8	2.2
Recent Uranium Sales:			
Number of Transactions[7]	8	8	4
Quantity of Material[8]	1.5	3.5	5.8
Nuexco SWU Values:[9]			
DOE origin, certifiable as excess, 0.3 tails assay; delivery before the end of FY86	88	90	—
Other SWUs (non-DOE or non-certifiable) delivery by the end of calendar year 1986	83	85	—
USDOE SWU Prices:			
USEC	135.00	135.00	135.00
AFC	153.00[10]	153.00[10]	153.00[10]
Requirements	157.00[10]	157.00[10]	157.00[10]
Market Value of Enriched UF_6[11] [12]:			
2.5 w/o U_{235}	452	456	513
3.0 w/o U_{235}	582	587	660
3.5 w/o U_{235}	714	721	810
4.0 w/o U_{235}	849	857	962

---

[1] US $ per pound U_3O_8 equivalent.

[2] US $ per kilogram U as UF_6.

[3] Per annum.

[4] US $ per pound U as UF_6.

[5] Active inquiries to sell, for delivery within 12 months after contract signing (millions of pounds U_3O_8).

[6] Active inquiries to purchase, for delivery within 12 months after contract signing (millions of pounds U_3O_8).

[7] Uranium sales only; does not include loans, conversion, or SWU transactions.

[8] Millions of pounds U_3O_8, equivalent.

[9] US $ per SWU.

[10] Effective 10/1/84.

[11] Calculated using the Nuexco Exchange Value, Conversion Value, and 0.30 percent tails assay. From 3/30/84 through 4/29/85, calculations used the Nuexco SWU Value for DOE origin and FY85 delivery. As of 4/30/85, calculations use the Nuexco SWU Value for DOE origin and delivery by the end of FY86.

[12] US $ per KgU as UF_6, rounded to the nearest $.

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EXECUTIVE SUMMARY
REPORT 203
(All data as of June 30, 1985)

Exchange Value
\$15.00, unchanged

The **Exchange Value** is **\$15.00** per pound U_3O_8, unchanged since last month. Eight recent natural uranium sales are reported, involving approximately 1.5 million pounds U_3O_8 equivalent. All involved delivery prior to 1986, and seven met the conditions for inclusion in the Transaction Value.

UF_6 Value
\$42.50, unchanged

The **UF_6 Value** is **\$42.50** per kilogram U as UF_6, unchanged since last month. Three transactions reported this month involved natural UF_6.

Supply-Demand Ratio
fell to 2.7:1

Active spot and near-term **uranium supply** amounts to **3.5 million** pounds U_3O_8 equivalent, up 865 thousand pounds since last month. Active spot and near-term **uranium demand** totals **1.3 million** pounds, up 385 thousand pounds. The spot and near-term **supply-demand ratio** fell to **2.7:1.**

Transaction Value
rose to \$14.60

The **Transaction Value** is **\$14.60** per pound U_3O_8, up \$0.15 since last month. The calculation includes 17 transactions involving a total of 4.6 million pounds U_3O_8 and equivalent UF_6, and covers a period of 3 months.

Loan Use Charge Rate
unchanged at 5%

The **Loan Use Charge Rate** is **5 percent** per annum, unchanged.

Conversion Value
rose to \$1.60

The **Conversion Value** is **\$1.60** per pound U as UF_6, up \$0.10 since last month. Active secondary market supply for conversion services for delivery within three years totals 1.7 million pounds U as UF_6. Active demand totals 365 thousand pounds U as UF_6.

SWU Values:
\$88 for DOE-origin
for delivery by
the end of FY86
\$83 for non-DOE origin
for delivery by the
end of calendar year 1986

The **SWU Value** for DOE origin at .3 tails and certifiable as excess, is **\$88** per SWU for delivery by the end of FY86. The SWU Value for other SWUs (non-DOE or non-certifiable) is **\$83** per SWU for delivery by the end of calendar year 1986. One secondary market SWU transaction is reported, involving 100 to 300 thousand SWUs.

Focus

Brazil's nuclear power program is proceeding at a slow pace, and ambitious plans for domestic fuel cycle facilities and uranium production operations are restrained by funding problems.

Annual Update

Within the next decade, Japanese utilities expect to add over 20,000 MWe to their considerable nuclear power program, and their past successes in nuclear power suggest that the goal will be attained. In addition, Japan has achieved significant progress in their commercial enrichment plans, as well as in other areas of the fuel cycle.

Australia

The joint venture partners in the Olympic Dam (Roxby Downs) uranium project have announced the viability of the project, as Nuexco expected. Their marketing success will depend largely on initial production costs.

United States

Several DOE decisions made in early June, including the decision to proceed with AVLIS enrichment technology, represent some of the first concrete measures taken by DOE to remedy its financial difficulties and the shrinking market share of its commercial enrichment program.

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AUGUST 1985

NUMBER 204

MONTHLY REPORT

ON THE NUCLEAR FUEL MARKET

NUEXCO

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MONTHLY REPORT ON THE NUCLEAR FUEL MARKET

August 1985 No. 204

R. WESLEY MILLER, *EDITOR* CLARK M. BEYER, *ASSOCIATE EDITOR*

PRICING

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To Our Readers

Nuexco is pleased to announce that an agreement has been reached under which Oren L. Benton will purchase control of Nuexco. This agreement has the enthusiastic support of Nuexco's shareholders and employees, including George White, Jr., Jim Vaughan, Bob Wolcott, Wayne Fowler and others. Oren has assumed the chief executive officer position of Managing Director. All of the above named individuals will be actively associated with Nuexco in various capacities.

Oren, age 51, is a Certified Public Accountant and a resident of Denver, Colorado. He was associated for nearly twenty years, until 1975, with the international accounting firm of Arthur Andersen & Co., where, as a general partner, he was a financial and tax consultant to utilities, natural resource companies, banks, and insurance companies. In 1975, he resigned from Arthur Andersen and, until 1982, was a consultant to Bob Adams and Vice Chairman of Energy Fuels. Following Bob's death, Oren served as an executor of the Adams' estate and, in early 1983, concurrent with the sale of Energy Fuels to John Adams, terminated his business relationship with that organization.

While continuing to serve as an estate executor, Oren also pursued other personal business and investment interests, and joined Nuexco's Board of Directors in August 1983. Oren's background as an independent consultant, together with his extensive involvement and experience in the international nuclear fuel industry, will accelerate the development and expansion of Nuexco's services to the industry.

* * *

Nuexco will host a hospitality suite during the Uranium Institute's Tenth Annual Symposium in London, England. The suite will be located at the Savoy Hotel, September 3-5. We look forward to seeing you there.

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NUEXCO

NATURAL URANIUM AND SECONDARY MARKET CONVERSION

The **Exchange Value** as of July 31, 1985 is **$15.75** per pound U_3O_8, up $0.75 since last month. **Active supply** of natural uranium (U_3O_8 and UF_6) for spot or near-term delivery totals **3,035,000** pounds equivalent U_3O_8 as concentrates or UF_6, down 485,000 pounds since last month. The corresponding figure for **active demand** is **455,000** pounds, down 870,000 pounds. The spot and near-term **supply-demand ratio** rose to **6.7:1.**

The *Current Market Data* section of this Report lists eight natural uranium sales transactions, involving a total of approximately 1,800,000 pounds U_3O_8 equivalent. Seven of the transactions reported this month involved deliveries in the near term, and four met the criteria for inclusion in the current Transaction Value calculation.

The **UF_6 Value** as of July 31, 1985 is **$44.00** per kilogram U in UF_6, up $1.50 since last month. Five of the transactions reported this month involved UF_6.

The **Transaction Value** as of July 31, 1985 is **$14.75** per pound U_3O_8, up $0.15 since last month. The current Transaction Value includes 17 transactions involving a total of 4.8 million pounds U_3O_8 or equivalent UF_6 and covers a period of 3 months.

The **Loan Use Charge Rate** as of July 31, 1985 is unchanged at **5 percent** per annum, as lenders continued to offer substantial quantities of material at that rate.

* * *

The Exchange Value rose to $15.75 as higher prices became evident in transactions and bids following the rise in sellers' offers that began last month. As is customary in moving markets, the gap between sellers' offers and buyers' bids has widened. When any firm demand materializes, sellers compete aggressively for the available business, sustaining the buyers' market that has prevailed for the past several years. In July, the strong response to one utility's demand for a large quantity of material continued the pattern.

Buyers shared the growing sense of market firming and, although most of the transactions reported this month involved UF_6, indicated that they were willing to pay above $15.50 per pound U_3O_8 equivalent. An important factor in that willingness was the decline of the US dollar relative to most currencies. Even after taking into account the five-percent rise in the Exchange Value (as expressed in US dollars), the value of uranium as expressed in most other currencies actually declined. For example, the table on page 4 of this Report shows that last month's Exchange Value was equivalent to 139.41 French francs, but declined three percent this month, to 135.43. Similar differentials applied to Belgium, the Federal Republic of Germany, Spain, Sweden, Switzerland, the United Kingdom, and others. Thus, most sellers outside the USA would need higher US dollar prices to avoid losing ground. On the other hand, most non-US buyers would be able to pay higher US dollar prices without losing anything in terms of their own currencies.

Traders again played an active role in this month's transactions. One US utility sold most of its inventory to traders, and shortly thereafter the material reappeared in the market at higher offering prices. Another effect of traders' activity was an apparent inflation of supply. Believing that several lots of material being offered (ostensibly on an exclusive basis) were actually being offered by multiple parties, one buyer remarked that he only expected to get two-thirds of the total quantity he had just agreed to purchase.

At present, many sellers are holding material (or offering it at prices well above the current Exchange Value) in anticipation of higher prices in the near term. Several utilities have indicated their intent to buy material in the last few months of 1985. Current demand for natural uranium is thin and sporadic. Buyers demanding natural uranium often prefer UF_6, so active demand for concentrates was low throughout July. However, several sources of firm demand for substantial quantities of concentrates are expected to appear in early August.

* * *

The UF_6 Value also rose as a result of the higher transaction prices and active trading in UF_6. Canadian suppliers have been able to sell large quantities of UF_6 (or U_3O_8 that *must* be converted at Eldorado) at competitive prices, and will be the dominant competitors for upcoming business, as they remain active while other producers often seem intent upon holding out for higher prices at the end of the year.

* * *

The **Conversion Value** is **$1.60** per pound U in UF_6, unchanged since last month. The supply of secondary market conversion services diminished as possible suppliers continue to stand apart from the market. Demand is at a minimum and little activity is expected in the coming weeks. No secondary market conversion transactions are reported. Active supply of secondary market conversion services for delivery within three years totals 360 thousand pounds U as UF_6. Active secondary market demand for conversion amounts to 425,000 pounds U in UF_6.

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PRICING

ENRICHED URANIUM AND SWUS

The Nuexco **SWU Values** as of July 31, 1985 are:

1. For **DOE origin,** a tails assay of 0.30 weight-percent U_{235}, for delivery by the end of FY86, and certifiable as excess, $85 per SWU, down $3.

3. For **other** SWUs (includes DOE origin SWUs not certifiable as excess and non-DOE origin SWUs), for delivery by the end of calendar year 1986, $81 per SWU, down $2.

Two secondary market SWU transactions are reported, involving less than 50 thousand SWUs.

* * *

The price distinctions between DOE-certifiable and non-certifiable or other origin SWUs are becoming less obvious as the markets converge. Prices continue to drop as opportunities appear one at a time and sellers cut their prices to complete the sale. The two SWU transactions reported this month involved small quantities of material, yet transaction prices illustrated the continuing downward drift of SWU prices. As in the past few months, buyers have been able to obtain lower prices with each succeeding sale, due to the seller competition and complete lack of any other demand. These conditions should apply for some time, and consequently little secondary SWU market activity can be expected.

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CURRENT MARKET DATA

July 31, 1985	Market Values	Active Supply[1] (thousands)	Active Demand[1] (thousands)
EXCHANGE VALUE	**$15.75**/lb. U_3O_8	3,035	455
UF_6 VALUE	**$44.00**/kgU		
CONVERSION VALUE	**$1.60**/lb. U as UF_6	360	425
SWU VALUES			
DOE origin, certifiable as excess, 0.3 tails assay delivery by the end of FY85	**$85**/SWU		
Other SWUs (non-DOE or non-certifiable) delivery by the end of calendar year 1986	**$81**/SWU		
LOAN USE CHARGE RATE	5%/annum	0	300

TRANSACTION VALUE

$/lb. U_3O_8	Millions of Pounds	Number of Transactions	Number of Months
14.75	4.8	17	3

---

[1] Supply and demand tables in the *Current Market Data* section of this Report detail the numbers for each category.

DEFINITIONS

1. The **Exchange Value** is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the date indicated.
2. The **UF_6 Value** is Nuexco's judgment of the price at which spot and near-term transactions for significant quantities of natural uranium hexafluoride could be concluded as of the date indicated.
3. The **Conversion Value** is Nuexco's judgment of the price at which spot and near-term transactions for significant quantities of conversion services could be concluded in the secondary market as of the date indicated.
4. The **SWU Values** represent Nuexco's judgment of the price at which transactions for the sale of significant quantities of SWUs of stated origin for delivery in the specified time period could be concluded as of the date indicated.
5. The **Loan Use Charge Rate** is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the date indicated.
6. The **Transaction Value** is a weighted average price of recent natural uranium sales transactions. The calculation is based on prices paid in:
   a. Transactions closed within the previous three-month period for which delivery is scheduled within one year of the transaction date;
   b. At least ten transactions;
   c. Transactions involving a sum total of at least 2 million pounds U_3O_8 equivalent.

   The sample time is extended as necessary to include these minima. Other currencies are converted to US dollars using conversion rates in effect on or near the transaction date.

DERIVATIONS AND COMMENTS

1. All Market Values are based on:
   a. Data from recently completed transactions.
   b. Data from pending transactions.
   c. Firm bids to buy or borrow, and firm offers to sell or lend.
   d. Prices purchasers or rates borrowers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy or borrow, and prices sellers or rates lenders have expressed a willingness to offer, but for which Nuexco is not aware of firm offers to sell or lend.
2. Prices associated with deliveries under old or renegotiated contracts or other than arm's-length transactions are not considered in the determination of these Market Values.
3. In the determination of the Conversion Value, Nuexco does not consider transportation charges other than those customarily provided by primary suppliers of conversion services.
4. The prices of conversion services or SWUs delivered under long-term contracts with primary suppliers are not considered in the determination of either the Conversion Value or SWU Value.
5. For the DOE SWU Values, Nuexco converts SWU prices at varying tails and product assays to equivalent SWU prices at a tails assay of 0.30 weight-percent U_{235} and a product assay of 3.0 weight-percent U_{235}, assuming feed costs corresponding to the Nuexco Exchange and Conversion Values determined as of the same date.
6. In calculating the Transaction Value, Nuexco does not account for the price of uranium delivered in connection with contracts which call for "market price" mechanisms. This exclusion applies particularly to contracts in which delivery prices are expressed as a function of future Exchange Values or any other indeterminant variable. Also excluded from the calculation are any other transactions in which the delivery price is defined in such a way that it cannot currently be determined.

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CURRENT MARKET DATA

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb. U_3O_8 in Concentrates This Month (July 31, 1985)	Last Month June 30, 1985)	12 Months Ago (July 31, 1984)	per kg. U in Concentrates This Month (July 31, 1985)	Last Month (June 30, 1985)	12 Months Ago (July 31, 1984)
Australia (dollar)	21.82	22.50	21.08	56.74	58.49	54.81
Belgium (comm. franc)	893.87	921.24	1,023	2,324	2,396	2,661
Canada (dollar)	21.29	20.45	23.01	55.35	53.16	59.82
Finland (markka)	93.14	95.12	106.58	242.14	247.28	277.08
France (franc)	135.43	139.41	155.42	352.08	362.42	404.05
FRG (mark)	44.50	45.76	50.64	115.70	118.96	131.64
Italy (lira)	29,689	29,222	31,117	77,185	75,972	80,896
Japan (yen)	3,739	3,732	4,304	9,721	9,703	11,189
Netherlands (guilder)	49.81	51.69	57.23	129.50	134.38	148.78
South Africa (rand)	32.21	29.50	28.62	83.74	76.69	74.40
Spain (peseta)	2,579	2,619	2,861	6,705	6,810	7,439
Sweden (krona)	130.38	132.04	146.81	338.96	343.28	381.68
Switzerland (franc)	36.33	38.34	43.08	94.46	99.68	112.00
UK (pound)	11.11	11.58	13.37	28.89	30.11	34.77
US (dollar)	15.75	15.00	17.50	40.95	39.00	45.50

TRANSACTION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb. U_3O_8 in Concentrates This Month (July 31, 1985)	Last Month (June 30, 1985)	12 Months Ago (July 31, 1984)	per kg. U in Concentrates This Month (July 31, 1985)	Last Month (June 30, 1985)	12 Months Ago (July 31, 1984)
Australia (dollar)	20.44	21.90	20.00	53.13	56.93	52.00
Belgium (comm. franc)	837.12	897.36	970.76	2,176	2,332	2,524
Canada (dollar)	19.94	19.90	21.82	51.83	51.74	56.74
Finland (markka)	87.23	92.58	101.10	226.77	240.69	262.83
France (franc)	126.83	135.69	147.42	329.72	352.76	383.27
FRG (mark)	41.68	44.54	48.03	108.35	115.79	124.87
Italy (lira)	27,804	28,443	29,516	72,284	73,946	76,736
Japan (yen)	3,502	3,632	4,083	9,104	9,444	10,614
Netherlands (guilder)	46.65	50.31	54.28	121.27	130.80	141.13
South Africa (rand)	30.16	28.71	27.15	78.42	74.64	70.57
Spain (peseta)	2,415	2,549	2,714	6,279	6,628	7,056
Sweden (krona)	122.10	128.52	139.26	317.44	334.13	362.05
Switzerland (franc)	34.03	37.32	40.87	88.46	97.03	106.24
UK (pound)	10.41	11.27	12.69	27.05	29.31	32.98
US (dollar)	14.75	14.60	16.60	38.35	37.96	43.16

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[1] Calculated using currency exchange rates published in the *Wall Street Journal* on July 31, 1985.

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CURRENT MARKET DATA

CONVERSION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

	per lb. U as UF_6			per kg. U as UF_6		
Country (currency)	This Month (July 31, 1985)	Last Month (June 30, 1985)	12 Months Ago (July 31, 1984)	This Month (July 31, 1985)	Last Month (July 31, 1985)	12 Months Ago (July 31, 1984)
Australia (dollar)	2.22	2.40	0.00	4.89	5.29	0.00
Belgium (comm. franc)	90.81	98.34	0.00	200.19	216.80	0.00
Canada (dollar)	2.16	2.18	0.00	4.77	4.81	0.00
Finland (markka)	9.46	10.15	0.00	20.86	22.37	0.00
France (franc)	13.76	14.87	0.00	30.33	32.78	0.00
FRG (mark)	4.52	4.88	0.00	9.97	10.76	0.00
Italy (lira)	3,016	3,117	0.00	6,649	6,871	0.00
Japan (yen)	379.87	398.11	0.00	837.46	877.68	0.00
Netherlands (guilder)	5.06	5.51	0.00	11.16	12.16	0.00
South Africa (rand)	3.27	3.15	0.00	7.21	6.94	0.00
Spain (peseta)	261.99	279.43	0.00	577.60	616.03	0.00
Sweden (krona)	13.25	14.08	0.00	29.20	31.05	0.00
Switzerland (franc)	3.69	4.09	0.00	8.14	9.02	0.00
UK (pound)	1.13	1.24	0.00	2.49	2.72	0.00
US (dollar)	1.60	1.60	0.00	3.53	3.53	0.00

SWU VALUES AND UF_6 VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	DOE SWU Delivery by the End of FY86 (July 31, 1985)	Non-DOE SWU Delivery by the End of CY86 (July 31, 1985)	UF_6 Value per kg. U in UF_6 This Month (July 31, 1985)	UF_6 Value per kg. U in UF_6 Last Month (June 30, 1985)
Australia (dollar)	117.78	112.24	60.97	63.75
Belgium (comm. franc)	4,824	4,597	2,497	2,612
Canada (dollar)	114.90	109.49	59.48	57.93
Finland (markka)	502.66	479.01	260.20	269.50
France (franc)	730.87	696.47	378.33	394.98
FRG (mark)	240.18	228.88	124.33	129.65
Italy (lira)	160,226	152,686	82,941	82,797
Japan (yen)	20,180	19,231	10,446	10,574
Netherlands (guilder)	268.82	256.17	139.15	146.45
South Africa (rand)	173.82	165.64	89.98	83.58
Spain (peseta)	13,918	13,263	7,205	7,422
Sweden (krona)	703.64	670.53	364.24	374.12
Switzerland (franc)	196.08	186.85	101.50	108.64
UK (pound)	59.96	57.14	31.04	32.82
US (dollar)	85.00	81.00	44.00	42.50

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[1] Calculated using currency exchange rates published in the *Wall Street Journal* on July 31, 1985.

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NUEXCO

CURRENT MARKET DATA

RECENT TRANSACTIONS[1]

Uranium Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U_3O_8 equivalent)	Approximate Price as Percent of Current Exchange or UF_6 Value	Seller	Buyer	Remarks
3506	1985-1986	301-600	see remarks	Canadian Producer	European Utility	UF_6. Market-related price, with ceiling.
3504	1986	101-300	100	Trader	US Utility	UF_6.
3503	1985	101-300	99	Trader	US Utility	UF_6.
3500	1986-1990	101-300	94-143	US Producer	US Producer	Series of fixed prices.
3498	1986	301-600	98	Canadian Producer	European Utility	
3497	1985	301-600	see remarks	Canadian Producer	European Utility	Market-related price, subject to ceiling and other provisions.
3494	1985	101-300	R[5]	Trader	US Utility	UF_6.
3493	1985	101-300	97	US Utility	Trader	UF_6

Enrichment Services
Secondary Market Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity[2] (thousands of SWUs)	Approximate Price[3] as Percent of Current SWU Value[4]	Seller Group	Buyer Group	SWU Origin	Remarks
3507	1986	less than 50	100	R[5]	US Utility	DOE	
3489	1985	less than 50	111	European Entity	US Utility	DOE	

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[1] Transactions listed are not limited to those in which Nuexco was involved, but also include others of which Nuexco is aware.

[2] If tails assay is unknown or unspecified, Nuexco's calculation of SWU quantity assumes 0.30 w/o tails assay.

[3] Price is not normalized to 0.30% tails assay.

[4] Refers to SWU Value that corresponds to SWUs included in transaction. When prices and SWU values are expressed as discounts (e.g., X dollars less than DOE's USEC base price at time of delivery), the percentage refers to the ratio of the *discounts*, not the ratio of the prices.

[5] The notation *R* means that Nuexco either does not know, or that Nuexco has restricted that information to protect client confidentiality.

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URANIUM SUPPLY
(July 31, 1985)

	Delivery Period[1] (Thousands of Pounds U_3O_8)		
Nuexco Project Number	**Spot or Near-term[2]**	**Intermediate or Long-term**	**Remarks**
Available for Sale:			
ACTIVE			
1860*	250	1,000 per year	UF_6
2134*	50	220 per year	1986-87
2335	275	—	
2389	300	—	
2483	545	—	
2654	500	500 per year	UF_6
2705A	200	—	UF_6
2711*	35	—	
2728*	200	500 per year	UF_6; 1986-90
2746*	180	—	UF_6
2814	500	500	UF_6
2625	—	250 per year	1987-89
2680	—	250 per year	1986-92
TOTAL:	3,035		
INACTIVE			
2191	125	—	UF_6
2336	250	250 per year	1985-94
2553	300	—	
2297	—	200 per year	1986-89
TOTAL:	675		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2670, 2673.

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CURRENT MARKET DATA

URANIUM DEMAND
(July 31, 1985)

	Delivery Period[1] (Thousands of Pounds U_3O_8)		
Nuexco Project Number	**Spot or Near-term[2]**	**Intermediate or Long-term**	**Remarks**
Inquiries to Purchase:			
ACTIVE			
2590	75	—	U_3O_8 or UF_6
2681*	250	500	UF_6
2757*	130	—	UF_6
2217	—	1,000 per year	1989-95
2507	—	600	1987-89
2741*	—	600	
2758*	—	500	UF_6
TOTAL:	455		
INACTIVE			
2548	290	—	
2576	20	—	UF_6
2636	100	—	
2676*	1,000	—	
2718*	250	350	
2414*	—	175	
2586	—	300	1987
2643	—	150 per year	1987 on
2694	—	625	1987; UF_6
TOTAL:	1,660		

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*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2457, 2695, 2750.

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LOAN SUPPLY AND DEMAND
(July 31, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Within 1 Year	Beyond 1 Year	Remarks
Available for Loan: **INACTIVE**			
1938	2,000	—	UF_6
2036	500	—	
2469A	800	—	
2483	550	—	
2667	800	—	
TOTAL:	4,650		
Inquiries to Borrow: **ACTIVE**			
2606	300	—	
TOTAL:	300		

*New or revised since last month.
[1] Measured from the date of this Report.
Projects removed since last month: None.

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CURRENT MARKET DATA

CONVERSION SUPPLY AND DEMAND
(July 31, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U as UF_6) Within 3 Years	Beyond 3 Years	Remarks
Available for Sale:			
ACTIVE			
2511	—	300	1986-90
2725	360	—	
TOTAL:	360		
Inquiries to Purchase:			
ACTIVE			
2587	35	—	
2596	—	600	
2617	275	420	1986-91
2709*	115	—	
TOTAL:	425		
INACTIVE			
2529	225	—	
2724	—	375	1989-93
TOTAL:	225		

*New or revised since last month.

[1] Measured from the date of this Report.

Projects removed since last month: 2419, 2438, 2677.

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SWU SUPPLY
(July 31, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of SWUs)		Remarks
	Spot or Near-term[2]	Intermediate or Long-term	
Available for Sale:			
ACTIVE			
2607	200	—	
2624	100	—	
2705	40	—	
2410A	—	350	
2571	—	55	1987
2684	—	35	
TOTAL:	340		
INACTIVE			
2359	—	200	
2378	—	120	1988
2652	—	25	1986
TOTAL:	0		

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*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes SWUs deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: None.

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SWU DEMAND
(July 31, 1985)

	Delivery Period[1] (Thousands of SWUs)		
Nuexco Project Number	Spot or Near-term[2]	Intermediate or Long-term	Remarks
Inquiries to Purchase:			
ACTIVE			
2400	—	150	1987-90
2519	—	30 per year	1987 on
2578	115	—	
2668*	—	15	
2747*	30	50	1987 on
TOTAL:	145		
INACTIVE			
2500	—	170	1988
2512	—	15 per year	1987 on
2595	—	50	1986
2693	—	100 per year	1989-90
2706	—	30	
TOTAL:	0		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes SWUs deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2543, 2597.

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OPTIMUM TAILS ASSAY—Part 4

(Note: The first three parts of this series on the Optimum Tails Assay were published in succession in Reports 195, 196, and 197, November 1984 through January 1985.)

Introduction

Part 1 of this series demonstrated that the *traditional* concept of the optimum tails assay (the tails assay for which the unit cost of enriched uranium product is a minimum) requires the assumption that the unit costs of feed material and SWU are both known constants. Part 2 discussed the variability of SWU prices with tails assays for a constant product cost, and extended the concept of minimum product cost to some instances of varying SWU price. Part 3 expanded the analysis to include the dependence of inventory carrying costs on the tails assay, and discussed a better definition of an optimum tails assay for nuclear fuel management. This fourth article addresses the DOE incentive SWU pricing plan's impact on the optimum tails assay for FY87-FY90 deliveries.

The Incentive Pricing SWU Option

Most of DOE's enrichment customers that converted to the USEC have accepted the incentive price option, which allows them to purchase additional SWU at a reduced price when those SWU are in excess of 70 percent of their requirements. The majority of these customers will be able to take 70 percent of their requirements under the original terms of the USEC and 30 percent under the incentive pricing rules.

The incentive pricing option applies to FY87 through FY90 deliveries; the incentive price will be $90 per SWU (fixed in 1987 and 1988 and escalated for 1989 and 1990). The price is based on DOE's variable cost of production. The price under the Utility Services enrichment contract (USEC) has been $135 in FY84 and FY85. For future years, DOE will apply a price ceiling of $135 escalated from 1984, and a FY86 price of approximately $125 is under consideration by DOE. In addition to lowering the base price, the incentive pricing option calls for a VTAO surcharge of zero. That is, customers accepting the incentive pricing plan will be allowed to vary the tails assay on the affected 30 percent of requirements at no additional charge.

DOE has established a policy dictating that the same tails assay must be used for both regular USEC and Incentive Price SWU. Thus, the cost of enriched product under the USEC with incentive pricing is given by the following equation:

$$\text{Product Cost} = \text{Feed Factor} \times \text{Feed Unit Cost} + \text{SWU Factor} \times [A \times \text{Incentive Price} + (1 - A) \times (\text{USEC Base Price} \times (0.86 + 0.7 \times \text{Tails Assay}))],$$

where A is the fraction of requirements delivered under the incentive pricing plan and the tails assay ranges from 0.20 to 0.30 w/o U_{235}.

Table 1 gives the optimum tails assay for FY87 as a function of uranium costs and SWU prices.

For any given feed cost, higher SWU prices tend to yield higher values for the optimum tails assay. However, the SWU price differentials in this case (Table 1) have relatively little impact on optimum tails assays. Thus, the optimum tails assay under the USEC (for any given feed cost) falls within an interval width of 0.02 w/o, whether the basic SWU price is $90, $125 or $135. Moreover, for most feed costs below $50 per pound U_3O_8, the interval width is only 0.01 w/o. Thus, the optimum tails assay is not sensitive to the customer's election of the incentive pricing option *under the USEC*.

Table 1

OPTIMUM TAILS ASSAY WITH INCENTIVE PRICING OFFER

	Optimum Tails Assay (in units of w/o)		
	Incentive Price	**USEC Price with VTAO Surcharge**	
U_3O_8 Cost ($/Lb.)[1]	**$90/SWU**	**$125/SWU**	**$135/SWU**
15	0.30	0.30	0.31
20	0.27	0.27	0.28
25	0.25	0.25	0.26
30	0.23	0.23	0.24
35	0.21	0.21	0.23
40	0.20	0.21	0.21
45	0.19	0.20	0.20
50	0.18	0.20	0.20

[1] Assumes $1.50 per pound U as UF_6 conversion cost.

Relationship to VTAO Surcharge

In reviewing the intent of the VTAO surcharge, it can be seen that this effect is definitely not a coincidence.

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Higher tails assays reduce the number of required SWUs, and DOE introduced the VTAO surcharge to cover the fixed costs associated with SWUs not delivered when higher tails assays were selected. In introducing the VTAO surcharge, DOE in essence reasoned that its customers should not be optimizing their tails assay based on the total cost of a SWU; approximately 30 percent of the total SWU costs are fixed, and should not be included in the optimization. The true product cost optimization equation should be:

Product Cost = Feed Factor × Feed Unit Cost
+ SWU Factor × Variable SWU Cost
+ Fixed SWU Cost.

When first analyzing the effect of the VTAO surcharge in Report 185 (January 1984), Nuexco observed that the optimum tails assay with the VTAO surcharge could be closely approximated by the optimum tails assay for the *variable cost of SUW without a surcharge.*

As long as the relationship between the incentive price, the USEC base price, and the VTAO surcharge is based on this cost/price philosophy, the parity between the optimum tails assays should still exist. In addition, this philosophy explains why there is no VTAO surcharge on the incentive price; the incentive price is based on variable costs, does not depend on the number of SWUs produced, and is therefore not a function of the tails assay.

Uranium Requirements

The incentive pricing plan should not measurably affect uranium consumption because it does not change the optimum tails assay from the one applicable to the USEC. However, if the real price of enrichment declines as a result of increased competition and improved technology, the optimum tails assay also will drop, and utilities will use less natural uranium and more SWU to obtain the required amounts of enriched product. However, uranium feed prices also influence the selection of optimum tails assays. As shown in Report 197 (January 1985), utilities should base their optimum tails assays on the expected cost of the next feed purchase, discounted if necessary for the future value of money. For a utility with no inventory, the spot market price would be a useful approximation. For a utility with five years of supply in inventory, the approximate feed value to use in optimizing fuel costs should be the expected 1990 U_3O_8 price, discounted by five years at the utility's cost of money. For example, if the utility could enter into a new contract today for delivery in 1990 at \$20 per pound U_3O_8 plus escalation (assuming escalation at 6 percent per annum and a discount rate of 12 percent per annum based on cost of money or on opportunity cost), the appropriate feed value would be:

$$\$20 \times (1.06/1.12)^5 = \$15.20 \text{ per pound } U_3O_8.$$

One of the few positive notes for producers, especially those in the USA, is that some utilities currently are taking deliveries of SWU at tails assays lower than their optimum. As the options available to them become more sophisticated, their U_3O_8 consumption per kilowatt hour could increase in the near term.

AUSTRALIA

Energy Resources of Australia's (ERA) Ranger mine produced approximately 6,694,000 pounds U_3O_8 in the fiscal year ending June 30, 1985. This figure coincides with current sales, and is one percent above the mill's rated capacity of 3,000 metric tons (mt) U_3O_8 per year (6,614,000 pounds). Tests have shown that the plant is capable of producing at a rate of over 4,000 mt per year. Since Ranger began operation in October 1981, it has produced over 25 million pounds U_3O_8.

NAMIBIA

Namibia's so-called transitional government, installed by South Africa in June, acquired an important stake in the Rossing uranium mine recently, when the Industrial Development Corporation of South Africa (IDC) transferred part of its 13.5-percent ownership interest to the new government. Although the transferred shares embody only 3.5 percent of the equity in Rossing Uranium Limited (RUL), they convey much more power. According to controlling stockholder Rio Tinto Zinc Corporation (RTZ), those shares account for a majority of the voting rights in Rossing by virtue of their being weighted more heavily than others. The transfer also gives the new government the right to nominate one of the nineteen members of the Rossing board; therefore, for the first time a Namibian government will have full access to information on the mine's operations.

The move is the first major change in the capital structure of Rossing Uranium Ltd. (RUL) since RTZ established it in 1974 as the operating company for the mine. However, as long as the government of Namibia is controlled from Pretoria, the change is more cosmetic than fundamental. A 1967 United Nations General Assembly mandate established the U.N. Council for Namibia as the *de jure* governmental authority for Namibia, but South Africa has retained control. Having been imposed over the objections of the council, the transitional government has so far failed to gain international recognition. In fact, the U.N. Security Council denounced the transitional government two days after its formal installation.

Rather than signifying any change in South Africa's policy on Namibia, IDC's transfer of Rossing equity to the transitional government is more properly regarded as a continuation of established policy. In that light, two likely objectives suggest themselves.

1. By giving it some economic influence, Pretoria probably hopes to enhance the likelihood of the transitional government's gaining acceptance by the people of Namibia. In that event, international recognition of the *de facto* government might become feasible.

2. The transfer could also serve to reduce the likelihood of legal action against RTZ and other companies for alleged exploitation of Namibia's natural resources under the Namibian Natural Resources Protection Act passed by the council in 1974. The act prohibits mining, processing or selling of Namibian resources without the council's consent. At present, the Council for Namibia is proceeding with legal action against Urenco, which enriches uranium for various European utilities that purchase Rossing uranium. The Dutch government's recognition of the act's validity prompted the council to seek the support of the Dutch government in a lawsuit against Urenco.

In the final analysis, South Africa's influence in the Rossing project is not likely to diminish noticeably given the new government's ties to South Africa. Furthermore, RTZ will retain its controlling interest and position as operator, so it is virtually certain that Rossing will be administered in a manner consistent with its recent past. (Table 2 indicates the revised equity distribution in RUL.) Nuexco projections indicate Rossing will produce approximately eight million pounds U_3O_8 in 1985. However, output could decline even further from the 1980 peak of 10.5 million pounds unless buyers are found to replace those whose contracts are running out in the near future.

Table 2

REVISED OWNERSHIP OF ROSSING URANIUM LTD.

Company	Country	Percent Share
Rio Tinto Zinc Corp.[1]	UK	41.35
Industrial Development Corp.	South Africa	10.0
Total Compagnie Miniere	France	10.0
Rio Algom Ltd.[1]	Canada	10.0
Urangesellschaft mbH	FRG	5.0
General Mining Corp.	South Africa	6.5
Windhoek government	Namibia	3.5
Undisclosed		13.65

[1] RTZ owns 51.3 percent of Rio Algom, so RTZ's net beneficial interest in Rossing is 46.5 percent.

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RECENT DEVELOPMENTS

SOUTH AFRICA

Second-quarter production from Chamber of Mines' producers amounted to 2,816,000 pounds U_3O_8, a 10.5-percent decline from the previous quarter (Table 3). The decline can be attributed to a 31-percent drop in production at Vaal Reefs, where throughput fell 22 percent and the yield declined 13 percent. Slight declines also occurred at Buffelsfontein and Harmony, while significant increases were reported at JMS (Free State Joint Metallurgical Scheme) and Randfontein.

Randfontein completed refurbishing work on its uranium plant during the second quarter, and as a result the plant in June achieved its rated production capacity of 300,000 metric tons of ore per month. Production at Western Deep Levels ceased during the second quarter; however, income continues due to sales of the company's stockpile of uranium.

* * *

Notwithstanding the recent escalation of political and social unrest in South Africa, no disruption in uranium supply is likely, for two reasons.

1. Most of the producers currently are holding large stockpiles of uranium. Nuexco estimates the nation's total in the range of 20,000,000 to 30,000,000 pounds U_3O_8, an amount sufficient to weather a complete cessation of production for a year or two.

2. Rioting has been confined to residential areas, and no protest has yet been directed against the mining industry.

The most immediate threat to mining in South Africa comes from the strike of black mineworkers scheduled for August 25. The National Union of Mineworkers, South Africa's largest black trade union, claims the strike would be honored by at least half of the nation's 550,000 black mineworkers and that it would affect 29 mines accounting for 70 percent of South Africa's gold production. The Chamber of Mines disputes those claims on several grounds.

1. In a recent vote regarding strike action, only 14 percent of the workers favored a strike. Subsequently, the union called for a conference of mineworkers to decide what action is necessary. The strike was approved by a special congress of 450 union delegates, not by a vote of the members.

2. The union is counting on support from nonmembers that may not materialize.

3. The union lacks the resources to support its members while on strike.

The strike can still be averted by negotiations. Multiple political and economic issues are at stake, as reflected in union demands for higher wages, shorter workweeks, etc. The union also wants an end to laws that prevent blacks from holding blasting certificates, a prerequisite to earning the formal designation of miner which would allow their advancement to higher pay levels.

The likely result of the current dispute is some form of economic concessions by management. However, if a strike does take place, it is likely to be short in duration. In any event, uranium supply will almost certainly not be disrupted.

Table 3
REPUBLIC OF SOUTH AFRICA:
1985 URANIUM PRODUCTION[1]
(Thousands of pounds U_3O_8)

Operation	First Quarter 1985	Second Quarter 1985	Year to Date
Beisa (St. Helena)	0	0	0
Blyvooruitzicht	0	0	0
Buffelsfontein	401	378	779
Chemwes (Stilfontein)	148	148	296
Dreifontein Consolidated	45	47	92
ERGO[2]	83	76	159
Harmony	256	225	481
Hartebeestfontein	239	222	461
JMS[3]	314	356	670
Randfontein	291	319	610
Vaal Reefs	1,156	799	1,955
Western Areas	150	189	339
Western Deep Levels	62	57	119
TOTAL	3,145	2,816	5,961

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[1] Excludes Palabora Mining Company, which is not a member of the Chamber of Mines.
[2] ERGO = East Rand Gold and Uranium Co. Ltd.
[3] JMS = Free State Joint Metallurgical Scheme.

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URANIUM PRODUCTION IN THE USA

Introduction

The USA, which once accounted for most of the uranium produced in the commercial market, will produce only about ten percent of the world's uranium in 1985. While the end of the decline may be in sight, there are still more producer failures to come. Producers continue to curtail activities, relegate projects to standby status, or cease operations. It is doubtful that many once-successful producers will ever be able to resume production. Even a substantial increase in market demand would probably not be sufficient to restore the industry to its former prominence, because of the strong market positions held by producers in other countries. Producers in Canada, and to a lesser extent, South Africa and Australia, have superior competitive positions—large deposits, much higher ore grades, and lower costs. Furthermore, the world's utilities hold more than five years' worth of inventories, so any substantial improvement in conditions is four to six years away. Former producers have only two real hopes, both of which are unlikely:

1. Discovery of large, high-grade orebodies that are cost-competitive with Key Lake, Cigar Lake, and others.
2. Government assistance, perhaps in the form of a limitation on the import of uranium.

Outlook for the 1990s

A new group of smaller, opportunistic companies could end up as the future uranium producers in the USA. Using new exploration and recovery techniques, different financial and marketing arrangements, and discretionary control of higher-grade ore within deposits, these new producers may be able to make average deposits profitable. Avoiding low-grade ore has become extremely difficult. Since 1979, the average grade of ore processed in the USA has been 0.115 percent U_3O_8. This indicates the poor quality of remaining US resources and exemplifies the problem forced on the producer industry. To be competitive in the future, the grade of new ore deposits must be considerably higher, perhaps in the range of 0.40 percent to 0.60 percent. The companies' success ultimately depends upon their ability to produce uranium on a competitive basis in the world marketplace.

Figure 1 illustrates the relationship since 1954 between uranium reserves, exploration drilling, and market value as measured by the Nuexco Exchange Value. Table 4 lists historical US uranium reserves by cost category, along with annual U_3O_8 sales (annual net change in commercial commitments of domestic-origin uranium to domestic buyers).

Table 4

ERDA/DOE ESTIMATES OF US RESERVES AND U_3O_8 SALES[1]

Year	Reserves by Cost Categories[2] $8	$10	$15	$30	$50	$100	U_3O_8 Sales[3] Annual	Cumulative	Nuexco E.V. (year end average) (US $ per lb. U_3O_8)
	(thousands of short tons U_3O_8)								
1966-1973	273						—	55.6	6.30
1974	277						11.9	67.5	15.00
1975	200	315	420	600			12.5	80.0	35.00
1976		270	430	640			13.8	93.8	41.00
1977		250	410	680			13.9	107.7	43.20
1978			370	690			15.8	123.5	43.25
1979			290	690	920		16.5	140.0	40.75
1980			225	645	936	1,122	17.5	157.5	27.00
1981			112	470	787	1,034	16.3	173.8	23.50
1982				205	594	894	14.0	187.8	20.25
1983				180	576	889	13.0	200.8	22.00
1984-2000				NA	NA	NA	121.2	322.0	15.25

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[1] Information adapted from ERDA/DOE 1974-1983 publications (Statistical Data of the Uranium Industry). See chapters on uranium resources, commercial U_3O_8 sales, and requirements.

[2] Uses "forward costs," comprising operating and capital costs, in present dollars, that will be incurred in production of the uranium. These include costs of labor, materials, electricity, royalties, payroll and production taxes, insurance, and applicable general and administrative costs. All previous expenditures (before the time of the estimate) for such items as property acquisition, exploration, mine development, mill construction, etc., are excluded. Also excluded are income taxes, profit, and the cost of money.

[3] Statistical Data of the Uranium Industry (USAEC), GJO-100 (83), page 65.

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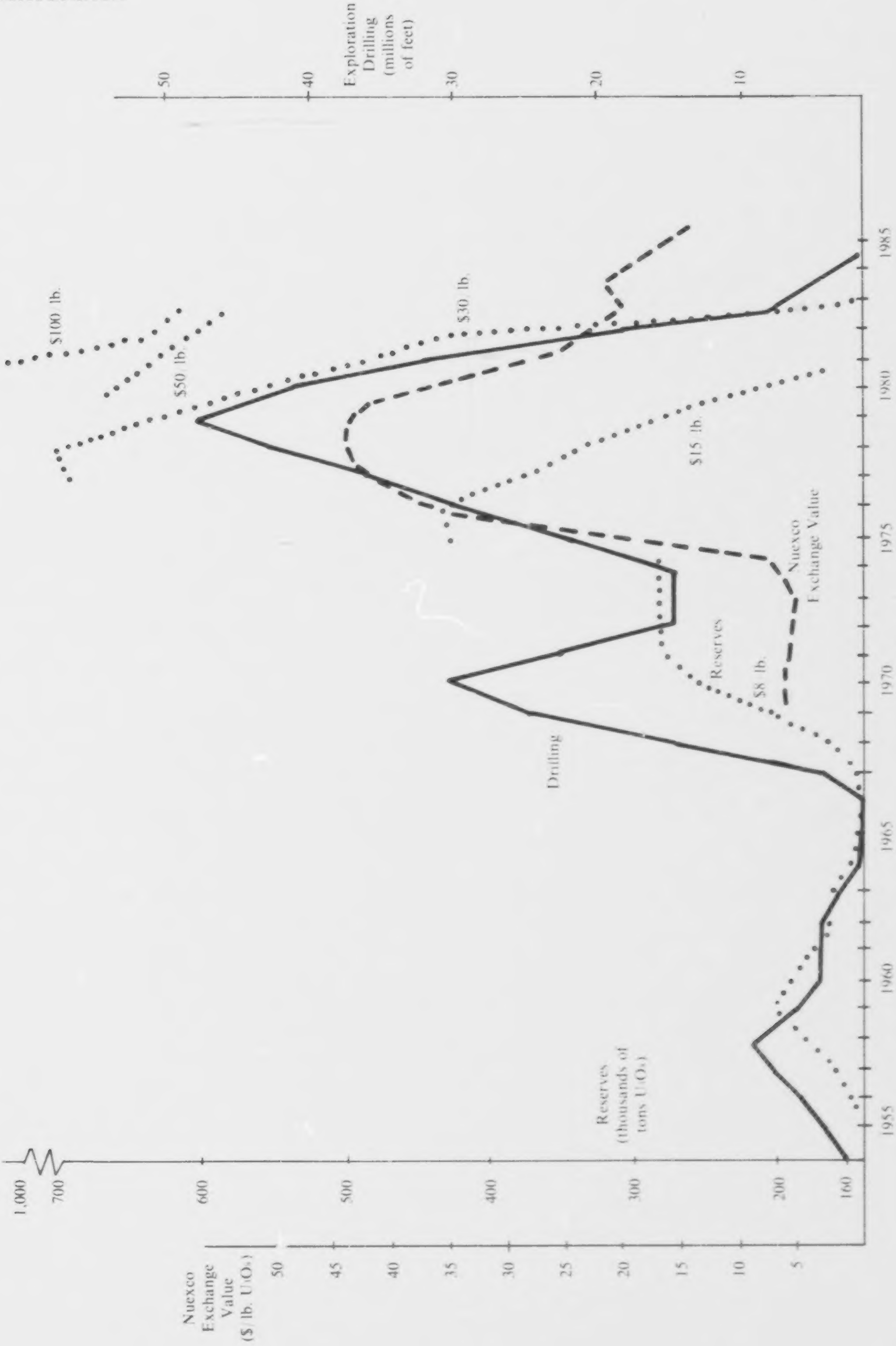

Figure 1. Relationship between uranium reserves, exploration drilling, and market value as measured by the Nuexco Exchange Value.

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Recent History—1981 to Present

The US producer industry has deteriorated markedly since early 1981. Mines and mills have been closed, properties with proven ore reserves have been abandoned, and exploration and production are at their lowest levels in about 30 years. (Although one new mill began operation in February 1985, two recently completed mills have not begun operation.) Many companies have terminated all uranium activities. The collapse in recent years can be attributed largely to two conditions of the market:

1. Intense competition for diminishing amounts of unfilled U_3O_8 requirements from foreign producers exploiting high-grade, low-cost deposits;
2. The low price of U_3O_8 (as measured by the Nuexco Exchange Value), which has fluctuated below $18.00 per pound since February 1984 and has fallen as low as $14.25 per pound, well below production costs for most US producers.

Some encouragement may be drawn from recent exploration successes in Nebraska, Virginia, and Arizona. In each case, significant ore deposits have been delineated, and commercial development may be feasible. In fact, the future of the US industry may depend upon the success of these types of new discoveries. The following significant events which have occurred in rapid succession within the past four years summarize some of the conditions which led to the depressed state of the industry in the USA.

1981

The gradual decline in activity throughout the uranium industry began to gain momentum in 1981. Exploration was highest in the South Texas district for the second consecutive year; the Grants, New Mexico district was one of the least active. The shift to Texas drew attention to the potential cost advantages of solution mining opportunities arising from the occurrence of shallow, low-grade deposits. New production capacity became available, but it was more than offset by mill closures. Some producers began to prepare for the difficult future predicted by analysts, but those whose high-priced contracts insulated them from the effects of declining market prices could afford to wait.

Discoveries: Crow Butte deposit, 25-30 million pounds U_3O_8, in Crawford, Nebraska; controlled by Wyoming Fuel Company (50 percent) and Ferret Exploration Company, Inc. (50 percent).

Project Start-ups:

1. Union Energy Mining Co., 3,000 ton-per-day (tpd) mill, Red Desert, Wyoming;
2. Ogle Petroleum Inc., solution mine, 400,000 lbs. per year, Bison Basin, Wyoming;
3. Tenneco, solution mine, 200,000 lbs. per year, Webb Co., Texas;
4. Freeport-McMoRan Inc., by-product of phosphoric acid, 420,000 lbs. per year, Donaldsonville, Louisiana.

Project Curtailments:

1. Conoco/Pioneer, 50 percent of mines and mill, Falls City, Texas;
2. Cotter, 33 percent of mines and mill, Colorado and Utah;
3. Exxon, 33 percent of mill, 50 percent of mine, Highland, Wyoming;
4. Petrotomics, 50 percent of mill, Shirley Basin, Wyoming;
5. Homestake, 33 percent of mill, Grants district, New Mexico;
6. Rio Algom, 50 percent of mill, La Sal, Utah. Combined average production loss = 40 percent, 5,900 tpd. Construction was completed on the Plateau Resources 750 tpd mill at Ticaboo, Utah, and the Bokum Resources 2,000 tpd mill at Marquez, New Mexico, but neither mill operated.

Project Closures:

1. Federal American Partners, all mines and mill, Gas Hills, Wyoming;
2. Union Carbide, Uravan, Colorado mill;
3. Western Nuclear, Irigaray solution mine, Powder River Basin, Wyoming;
4. Pioneer Nuclear, four mines, Uravan district, Colorado;
5. Sohio, mine and mill at Seboyeta, New Mexico;
6. Ranchers, Hope mine, Grants district, Colorado;
7. Phillips, Nose Rock mine, Crownpoint, New Mexico;
8. Homestake, one mine, Grants district, New Mexico. Approximate production loss of 3,950 tpd.

Projects Deferred:

1. Conoco, one mine, Crownpoint, New Mexico, and JD7 mine, Uravan district, Colorado;
2. Cleveland Cliffs Iron, two mines and mill, Pumpkin Buttes, Wyoming;
3. Homestake, Pitch mill, Gunnison, Colorado;
4. Amoco Minerals, all projects;
5. Wyoming Mineral Corp., all projects.

1982

The reduction of exploration drilling to 6.1 million feet during the year, down from 14.1 million in 1981, illus-

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trates the further decline in activity. The announcement of an important discovery in Virginia was offset by the general decline in number of operating companies. The major oil companies exhibited this pattern, as eight out of fifteen elected to abandon projects; only about 23 companies were active at the beginning of the year. Most exploration activity occurred in Arizona and Nebraska. French American Metals Corporation (a subsidiary of the French conglomerate Cogema) acquired 80 percent of Pathfinder Mines, Inc., raising speculation that the overall situation might improve, but other takeovers were not imminent. The Nuexco Exchange Value fell from $23.00 to $17.00, returning to $20.25 by the end of the year. The slight price increase, though short-lived, provided some optimism for industry participants, but it did not fundamentally alter subsequent events. Production declined to 26.8 million pounds U_3O_8, a drop of 32 percent.

Discoveries:

1. Swanson deposit, over 30 million lbs., Pittsylvania Co., Virginia, controlled by Marline Uranium Corp.;
2. Dena Rich deposit, 5-7 million lbs., Grants district, New Mexico, controlled by Midas International, Inc.;
3. Crow Butte deposit reserve estimate revised upward to approximately 44 million lbs.

Project Start-up: Plateau Resources, 750 tpd mill, Ticaboo, Utah.

Project Curtailments:

1. Atlas Corp., 50 percent of mines and mill, Moab, Utah;
2. Western Nuclear, 40 percent of all mines and two mills, Wyoming and Washington;
3. Exxon, 30 percent of surface mine and mill, Highland, Wyoming;
4. Homestake, 20 percent of mill, Grants district, New Mexico;
5. Kerr-McGee, 40 percent of mines and mill, Grants district, and 20 percent of mines, Church Rock, New Mexico;
6. Union Carbide, 50 percent of mine, Gas Hills, Wyoming, and 50 percent of mines, Uravan district, Colorado.

Project Closures:

1. Gulf Minerals, Mariano Lake mine, Mt. Taylor mine, Grants district, New Mexico;
2. Kerr-McGee, Lee mine shaft, Grants district, New Mexico;
3. Sunedco, closed out all exploration;
4. Western Nuclear, Ruby #3 and #4 mines, Grants district, New Mexico, Sherwood mine and mill, Wellpinit, Washington;
5. Phillips Petroleum withdrew altogether from the mineral industry;
6. Conoco terminated all mineral activity;
7. Texaco phased out all uranium projects;
8. Sohio withdrew from all uranium projects, Seboyeta, New Mexico assigned to Sohio subsidiary, Kennecott Copper;
9. Dawn Mining Co., mill at Ford, Washington. Approximate production loss of 2,450 tpd.

Related Activities:

1. Atlas Corp. purchased Exxon's ore deposit, Shootaring Canyon, Utah;
2. Pioneer Nuclear received radioactive materials license for Slick Rock, Colorado project;
3. Sohio renewed radioactive materials license for mill, Seboyeta, New Mexico;
4. Anaconda received radioactive materials license, Rhode Ranch project, South Texas district;
5. TVA purchased 17,000 acres of land from Federal-American Partners, Gas Hills district, Wyoming;
6. Marline Uranium and Union Carbide formed joint venture to evaluate the Swanson ore body, Pittsylvania Co., Virginia.

1983

The uranium market stabilized briefly as the Nuexco Exchange Value rose to $24.00 by mid-year, falling to $22.50 in December. However, production dropped to 21.2 million pounds and exploration drilling experienced another 50-percent decline to 3.2 million feet. That figure was 97 percent below the high of 47 million feet drilled in 1978. The Arizona Strip north of Grand Canyon National Park was the most active exploration area for the second consecutive year. At least five major companies were involved in the area. Energy Fuels continued to have modest success in locating new reserves, and at present operates three mines and is developing another. In general, however, mine and mill production continued to decline.

Discoveries:

1. Canyon breccia pipe, Yavapai Co., Arizona, controlled by Energy Fuels.
2. A small, high-grade deposit at Carpenter Flat, Uravan district, Colorado, controlled by Mineral Recovery Corp.

Project Start-ups:

1. Everest Minerals, Mt. Lucas solution mine, 400,000 lbs. per year, South Texas district;

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2. Pathfinder Mines, underground mine off pit wall, 2R South pit, Gas Hills, Wyoming;
3. Energy Fuels, exploration shaft, Pigeon pipe, Arizona Strip, Arizona.

Project Curtailments:

1. Homestake dismissed 40 employees in Grants district, New Mexico;
2. Union Carbide dismissed 197 employees and shut down mines and mill at Uravan district, Colorado, and dismissed 104 employees at Gas Hills, Wyoming.

Project Closures:

Union Energy Mining Co., Sweetwater mine and mill, Red Desert, Wyoming;

2. Energy Fuels, all mines and mill, White Mesa project, Blanding, Utah;
3. Homestake, Pitch mine, Gunnison, Colorado;
4. Union Carbide, Uravan mill, Uravan district, Colorado.

Approximate mill production loss of 6,300 tpd.

Related Activities:

1. Everest Minerals purchased Exxon's mines and mill in Highland, Wyoming;
2. Mobil received approval for new processing plant in Crownpoint, New Mexico;
3. Wyoming Mineral purchased Conoco's 50-percent interest in the Crownpoint, New Mexico project;
4. Conoco sold its Ruby Ranch project in Powder River Basin, Wyoming, to Santa Fe Mining;
5. Energy Fuels received authorization for an exploration shaft on the Kanab North project in the Arizona Strip, Arizona;
6. Rio Algom purchased the Mi Vida mine in La Sal, Utah, and increased mill production to 750 tpd;
7. US DOE transferred all responsibility from Grand Junction, Colorado to Energy Information Administration, Washington, D.C.;
8. Kerr-McGee reorganized nuclear operations—New Mexico operation became Quivira Mining Co., and all other operations became Sequoyah Fuels Corp.

1984

US production fell to 15.6 million pounds. For the first time, the USA was no longer the largest-producing country in the world, as Canadian production reached 29.1 million pounds U_3O_8. The Nuexco Exchange Value at the beginning of the year was $20.25 and by December had fallen to $15.50, its lowest level since January 1975. Exploration drilling amounted to less than 2.5 million feet, the lowest total since 1952. The Arizona Strip again was the most active area, and a slight surge of interest arose when at least five major companies and eight small exploration companies and independents began competing for new exploration targets. Most other projects were curtailed or closed until favorable changes in the market occurred.

Project Start-up: Western Nuclear reopened Ruby Wells mine, 550 tpd, in Grants district, New Mexico;

Project Curtailments:

1. Quivira Mining Co., 40 percent of mines and mill, Grants district, New Mexico;
2. Union Carbide terminated all exploration in Grand Junction, Colorado.

Project Closures:

1. Atlas Corp., three mines and one mill in Moab, Utah;
2. Exxon, mine and mill in Highland, Wyoming;
3. Caithness Corp., McBryde solution mine in South Texas district, Texas;
4. Tenneco Minerals, West Cole solution mine in South Texas district, Texas;
5. Plateau Resources, mine in Ticaboo, Utah;
6. Western Nuclear closed mill in Wellpinit, Washington, after a five-month run;
7. Homestake, mill, Grants district, New Mexico;
8. Union Carbide closed two mills in Gas Hills, Wyoming and Uravan, Colorado after a four-month run;
9. Pathfinder Mines, underground mine, 2R South pit, Gas Hills, Wyoming.

Approximate production loss of 12,700 tpd.

Related Activities:

Union Carbide acquired control of White Mesa mill from Energy Fuels, which reserved 30 percent of capacity, Blanding, Utah;

2. Ranchers merged with Hecla Mining Co.;
3. Union Carbide's mineral resources will operate under subsidiary of UMETCO Minerals Corp.;
4. Energy Fuels applied for permits to develop the Canyon breccia pipe, Yavapai Co., Arizona;
5. Pathfinder Mines announced it will modernize Lucky Mc mill in Gas Hills, Wyoming.

1985

There now are fewer active US uranium exploration and development companies than at any time since 1950. Only five conventional mills were operating at mid-year, most at a reduced rate averaging 3,700 tpd in spite of an

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average design capacity of 9,450 tpd; most support mines are operating at the same rate. Nuexco's estimate for 1985 exploration drilling is 1.8 to 2.2 million feet; Nuexco's latest forecast of 1985 production is less than ten million pounds, 40 percent of which will be produced by solution and phosphate mining.

Project Start-ups:

1. Wyoming Fuel/Ferret Exploration began construction on a 100-gallon-per-minute solution mining pilot plant at the Crow Butte project, Crawford, Nebraska, and projected annual start-up in the fourth quarter of 1985;
2. Chevron Resources resumed mining at Mt. Taylor in the Grants district, New Mexico for trial period of six to twelve months.

Project Closures:

1. Homestake, mines and mill after a four-month run in the Grants district, New Mexico;
2. Cotter Corp., mill, Cañon City, Colorado. (Plan to reopen in fourth quarter 1985.)

Related Activities:

1. Western Nuclear suspended all uranium operations and plans to sell all assets;
2. Gulf Minerals transferred base of operations from Denver, Colorado to San Francisco, California;
3. Amoco transferred all mineral projects to Cyprus Minerals.

Conclusion

The weak competitive position of US producers accounts for the barrage of mine closures and curtailments over the past five years. In the face of ever-strengthening foreign competition, attrition from the pool of US producers will continue. Absent any government intervention or sharp rise in market price, the US industry probably will continue to search for alternative methods for lower-cost production and richer orebodies. Though they are dwindling in number, those producers having lucrative long-term contracts may be able to survive through the end of the decade.

Many producers and observers believe that governmental intervention will be required, such as that proposed by the Uranium Producers of America (UPA). UPA is calling for changes in enrichment policy and restrictions on uranium imports, in addition to other measures, in order to revive the industry. Nevertheless, it is doubtful that efforts through political channels will be sufficient to revive the US production industry.

The following Appendix recounts the history of US uranium production and prices, dating back to the US AEC procurement of uranium for weapons programs. It also includes information on utility participation in uranium supply ventures.

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APPENDIX

Introduction

The history of the US uranium production industry is characterized by two distinct yet overlapping sources of demand: 1948 to 1970, and 1966 to the present. The US government initiated commercial uranium production in 1947 and, throughout that initial era, dictated the price of uranium through procurement policies implemented by the Atomic Energy Commission (AEC). Following a brief transitional phase, free market forces took over as the determinant of uranium prices, and today are the basis for the fluctuations in the market price. The early period witnessed the rapid expansion of the uranium mining industry in response to incentives offered by the governments of the US and the United Kingdom for uranium destined for use in their respective weapons programs. As stockpiles grew, the demand for uranium declined rapidly and the uranium mining industry fell into a recession. In the second era, the gradual growth of demand for uranium as fuel for nuclear power plants stimulated a recovery of the mining industry. The expansions and contractions which characterized the second era resulted from the changing balance between the fundamental demand for uranium as reactor fuel versus the demand to fulfill enrichment contracts. The inflexibility of the fixed-commitment enrichment contracts led to a catastrophic buildup of inventories throughout the fuel cycle; that inventory overhang plagues the industry now and will depress market prices for years to come.

The early success of the AEC procurement program can be attributed in part to the large number of independent prospectors who made initial discoveries in many of the important uranium districts. By the mid-1950s, however, the prospector was displaced by newly organized mining companies and joint-venture partners combined with the effects of changing government purchasing practices. Major international mining companies later assumed the dominant role, only to be supplanted in recent years by foreign competition, oversupply, unfavorable economics, and continuing regulatory changes.

The AEC Program

Government agencies have influenced the US uranium industry to some degree since its inception. Two phases of the first era (1947 to 1970) were the direct result of U_3O_8 procurement and policy changes instigated by the AEC. In the early years of the AEC uranium procurement program, the primary objective was to obtain uranium for weapons programs, so the AEC set up eleven *buying stations* and paid price incentives for ore delivered to the stations. Minimum base prices for ores of various types and grades were guaranteed by the AEC, in addition to quantity and development allowances and initial production bonuses. Table 5 is a partial schedule of AEC pricing structure and incentives.

The discovery of the large, high-grade Mi Vida deposit in 1952 prompted a surge of activity, and provided incentive for major energy companies to enter the uranium industry. In the following years, important discoveries occurred in the Gas Hills and Shirley Basin of Wyoming, in Ambrosia Lake, New Mexico, and in the South Texas district. Seven privately owned processing mills were in operation by 1953. That year, ore sales to mills and the buying stations totaled almost 200,000 tons of uranium ore. Throughout this period in the industry's history, as shown in Table 6, the average price paid by the AEC for uranium ranged from $7.14 in 1948, to $12.35 in 1953 and $8.15 in 1961.

The number of operating mines increased steadily, reaching an all-time high of approximately 750 by mid-1956; twelve mills were operating at a capacity of over 9,200 tons of ore per day. However, by year-end, exploration and development activity began to decline as the result of an AEC announcement that a new uranium procurement program would begin April 1, 1962. The AEC buying price would be set at $8.00 per pound U_3O_8. The announcement had a devastating effect on the industry. Many independent producers and small companies abandoned the industry permanently. The larger, well-established mining companies were able to survive the AEC policy change, but the era of the independent producer had ended.

The new program extended the procurement policy through December 1966, and the industry responded to the new program by further curtailing exploration. Despite drilling decreases, some important new discoveries were made.

Because of successful exploration and development programs, ore reserves and milling capacity had increased significantly by 1957. The AEC's procurement policy had achieved its goals, and thus, the AEC announced in May 1958 that the government would buy only a limited quantity of concentrates mined from ore deposits developed prior to November 24, 1958. The reduction in exploration activity was immediate, declining from 9.2 million feet drilled in 1957 to 5.6 million feet drilled in 1960. The number of operating mines had decreased to 590 by the end of

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1960, but operating mines had increased to 26, the highest number to date.

Another major policy change occurred in 1958. The AEC announced in May that it would allow private sales of uranium concentrate to domestic and foreign buyers provided it was used for peaceful purposes. All sales would be subject to AEC license approval. This event had been anticipated for some time, but it was not implemented in a timely fashion. A number of producers became impatient waiting for the private market to develop, so they halted activity. A flurry of activity that producers may have expected following the announcement did not occur; the first sale of domestic material to a private entity was not made until 1966.

In 1962, faced with a growing stockpile, the AEC adopted the previously announced procurement program which lowered the established purchase price to $8.00 per pound U_3O_8 through 1966. However, the continued viability of the US producer industry was in question, so the AEC included a provision that extended the procurement program by three years, through 1970. The *stretch-out* program, whereby producers could voluntarily defer delivery of their 1963-1966 contract commitments until 1967 and 1968, applied to contracts with the AEC after 1966. In return the AEC agreed to purchase in 1969 and 1970 additional uranium equal to the amount deferred. Eleven of seventeen milling companies participated in the stretch-out program; meanwhile, the number of active mines fell below 400.

The passage in 1964 of the Private Ownership of Special Nuclear Materials Act (Public Law 88-489) officially ended the government's monopoly on the use of uranium. The Act was intended to encourage the private sector to participate in the commercial use of uranium for power generation. However, the decline in demand for uranium for nuclear weapons was not immediately offset by the growing use of uranium for electricity generation. Consequently, the AEC dropped its options to purchase non-US (mostly Canadian) uranium, and in 1966 the government placed an embargo on the enrichment of foreign uranium for use in domestic power plants. Stockpiling and forward buying of uranium in anticipation that the embargo would be lifted were not prohibited. This situation led to the formation of large stockpiles in the USA, Canada, and South Africa. The embargo offered some assurance that sufficient domestic capacity would be available to maintain a viable producer industry. The AEC estimated domestic requirements at 15.6 million pounds U_3O_8 in 1968, growing to 186.0 million pounds by 1975 (the estimate was downgraded in 1971 to 132.4 million pounds).

Large stockpiles, worldwide overproduction, and a

Table 5

PARTIAL SCHEDULE OF AEC PRICES FOR URANIUM ORE

Grade of Ore, Percent U_3O_8	Pounds of U_3O_8 per Ton of Ore	Base Price		Grade Premium		Mine Development Allowance 50¢/lb.	Price per Ton of Ore		
		Pound U_3O_8	Ton of Ore	75¢/lb. Over 4 lbs.	25¢/lb. Over 10 lbs.		Price Before Initial Production Bonus & Haulage Allowance	Initial Production Bonus on 10,000 lbs.	Price Before Haulage Allowance
0.10	2.00	$1.50	$3.00	—	—	$1.00	$4.00	$3.00	$7.00
0.15	3.00	2.50	7.50	—	—	1.50	9.00	7.50	16.50
0.20	4.00	3.50	14.00	—	—	2.00	16.00	14.00	30.00
0.25	5.00	3.50	17.50	0.75	—	2.50	20.75	17.50	38.25
0.30	6.00	3.50	21.00	1.50	—	3.00	25.50	21.00	46.50
0.35	7.00	3.50	24.50	2.25	—	3.50	30.25	24.50	54.75
0.40	8.00	3.50	28.00	3.00	—	4.00	35.00	28.00	63.00
0.45	9.00	3.50	31.50	3.75	—	4.50	39.75	31.50	71.25
0.50	10.00	3.50	35.00	4.50	—	5.00	44.50	35.00	79.50
1.00	20.00	3.50	70.00	12.00	2.50	10.50	94.50	70.00	164.50
5.00	100.00	3.50	350.00	72.00	22.50	50.00	494.50	350.00	844.50

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Table 6

AVERAGE PRICE PAID BY AEC FOR DOMESTIC URANIUM PURCHASES[1]

(Fiscal years 1948-1971)

Fiscal Year	**Average Price (US $ per pound U_3O_8)**
1948	7.14
1949	8.53
1950	9.11
1951	10.10
1952	11.18
1953	12.35
1954	12.27
1955	12.25
1956	11.51
1957	10.49
1958	9.45
1959	9.12
1960	8.75
1961	8.50
1962	8.15
1963	7.82
1964	8.00
1965	8.00
1966	8.00
1967	8.00
1968	8.00
1969	6.99
1970	5.74
1971	5.54
Overall Average	$8.52

Source: "Statistical Data of the Uranium Industry" (US Department of Energy, Grand Junction, Colorado), GJO-100 (80), p. A-2.

[1] Purchases are shown for the year in which the concentrate was received in accordance with contract provisions. Uranium recorded as a by-product from the processing of phosphates, euxenites, etc., is not included.

reluctance by utilities to enter into long-term supply contracts characterized the market in the late 1960s. Therefore, the prices given in Table 6 do not represent a market equilibrium price as would have been determined by the unhindered interaction of supply and demand. During the 1950s, prices were deliberately maintained at a level which enabled the USA and UK to build up their nuclear weapons inventories and to establish their strategic stockpiles. Stockpiling, stretch-out programs, and the growth of demand from utilities combined with an embargo on uranium imports to shelter US producers from the possibility that competition might have determined a price uneconomic for them. During this period, non-US producers were selling uranium concentrates at prices considerably below those established by the AEC.

Industry response to the rash of AEC policy changes was to curtail exploration, development, and production throughout the early-to-mid 1960s. The level of exploration activity began to recover in 1966, coinciding with the enactment of the embargo. Drilling increased from 2.1 million feet in 1965 to a high of 29.9 million feet in 1969. Development of new mines increased in 1966 and production in 1967. Production gradually increased from 20 million pounds U_3O_8 in 1966 to more than 26 million pounds by 1970, when the AEC program ended. The AEC purchased over 348 million pounds of uranium concentrates during the span of its procurement program. While government jurisdiction over the industry has endured, virtually all subsequent uranium sales have occurred in the private sector.

Transition to a Commercial Market

The first sale of uranium to a private utility occurred in 1966. General Public Utilities signed a contract to supply its Oyster Creek Unit 1, and other sales followed as utilities embarked on nuclear power plant construction programs. Orders for uranium concentrates began appearing at prices below the $8.00 per pound level then being paid by the AEC. At the end of 1970, AEC purchases ceased when its stockpile amounted to approximately 50,000 short tons U_3O_8. Because of the considerable time lag between plant order and date of commercial operation (and also due to the fact that Westinghouse had agreed to supply buyers of its reactors with uranium at fixed prices over the plant's early years of operation), the demand for uranium was not expected to increase until the mid-1970s. Thus, from 1968 to 1972, prices continued to decline as a result of excessive supply, overproduction, and delays in the licensing and construction of nuclear plants.

The largest industrial buyers were the reactor manufacturers—Westinghouse Corp., General Electric Corp., Babcock & Wilcox Co., and Combusion Engineering Corp.—which often agreed to provide fabricated fuel for their utility customers, in the process agreeing to furnish all the necessary goods and services constituent to the fuel. Certain utilities chose to purchase their uranium supplies independently, and by late 1967 the volume of utility purchasing exceeded that of the fabricators. The uranium

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industry resumed extensive exploration and orebody development. By mid-1967, the number of major participants had increased to at least 50, of which 15 were oil companies with large exploration and development budgets. In addition, domestic and foreign utilities became active in exploration, usually as joint venture partners with the leading mining companies. The industry rapidly became more competitive. This surge of activity slowed considerably when the perceived potential for a shortage of uranium resources in the US caused plant orders to decline in early 1968. However, the momentum of exploration and development activity carried most programs into the early 1970s, as illustrated by the high drilling rate of 29.8 million feet in 1969.

Establishment of a Spot Market Price

In September 1968, Nuexco (then Nuclear Exchange Corporation) published its first report on the uranium market. In it, Nuexco attempted to describe by means of a price judgment the state of the spot or near-term market for uranium as of the publication deadline for each issue. The price, now known as the Nuexco Exchange Value, has undergone numerous changes, in definition and in the various factors that influence it, yet it remains the leading indicator of spot or near-term market uranium prices. The depressed prices of the 1968 to 1972 period are evident in Exchange Values for that period (see Historical Market Data in this Report).

The Early 1970s

Faced with continuing oversupply, low U_3O_8 prices, few reactor orders, and the termination of the AEC procurement program in December 1970, industry participants began to curtail or abandon projects. Seventeen mills were in operation at the end of 1972, and production amounted to 26 million pounds U_3O_8. Surface drilling dropped to 23.5 million feet in 1970 and 15.4 million feet in 1972. The AEC then estimated ore reserves less than $8.00 per pound to be 273,000 tons U_3O_8. For the first time, the AEC publicly discussed ore reserves based on cost categories of $10.00, $15.00, and $30.00 per pound.

Activity increased in the second half of 1973 as utilities made agreements for the delivery of approximately 45,000 tons U_3O_8 from 1974 to 1994. AEC records indicate that commercial sales to domestic utilities had increased by 90,600 tons U_3O_8 since 1970, and totaled 175,600 tons U_3O_8 for delivery during the 1974-1994 period. Sales to foreign utilities totaled 6,900 tons U_3O_8, of which 5,700 tons had been delivered by the end of 1973.*

Two events that had a profound effect on the uranium production industry occurred within a six-month period. First, in October 1973, OPEC (Organization of Petroleum Exporting Countries) introduced a worldwide oil embargo, which led to dramatically higher energy prices, including those of coal and natural gas. The embargo led many observers to fear a worldwide energy shortage, and forced utilities to reevaluate the nuclear energy option. Utilities reacted quickly, placing new orders for nuclear plants and attempting to secure uranium supply contracts of unprecedented length. They also became less concerned about price, and U_3O_8 prices began to rise as a result. The Nuexco Exchange Value increased from $6.50 to $6.75, the highest level recorded by Nuexco, one month after the embargo announcement. By the end of 1974, the Exchange Value had reached $15.00; exploration drilling had increased to 22.0 million feet and exploration expenditures totaled $80 million. The AEC estimated total ore reserves in all cost categories at 600,000 tons U_3O_8.

The second important event occurred in early 1974, when the AEC announced a change in its uranium enrichment policy. The Requirements-type contract, which allowed customers ample flexibility, was replaced with the Long-Term, Fixed-Commitment Contract. The new contract obligated utilities to furnish feed material for enrichment under long-term contracts without allowing for reductions in reactor requirements, thereby inducing them to incur long-term obligations for uranium supply. Utilities responded by quickly filling future U_3O_8 requirements with purchase contracts for delivery in the early 1980s and beyond. Utility purchases increased from 175,600 tons U_3O_8 in the beginning of 1974 to 289,200 tons at the end of 1977. In addition, US utilities entered purchase commitments with foreign producers totaling 39,200 tons U_3O_8, while US producers sold 6,600 tons to foreign utilities.

Several other events had similar effects on uranium prices and upon pricing mechanisms during this period:

1. The US government announced its decision to reduce its stockpile by operating its enrichment plants at higher tails assay than specified in its service contracts. This action (called the split-tails policy) relieved the downward pressure on the price of uranium that was caused by the existence of a stockpile of approximately 50,000 short tons U_3O_8.

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*Statistical Data of the Uranium Industry (USAEC, January 1, 1974), GJO-100 (74), page 58.

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2. Westinghouse announced in 1975 that it would not honor its agreements to supply uranium at fixed prices, so utilities took action to satisfy requirements that they previously had considered covered.

3. An international cartel was formed to protect the non-US uranium producers. Its effect on price has been the focus of a great deal of study, but the results are still being debated.

The Nuexco Exchange Value rose sharply from 1974 to 1976; fixed-price contracts declined in importance and contracts containing provisions for market-related pricing became popular. Contract rigidities, however, served to moderate the post-1973 price surge. Producers forced the renegotiation of numerous contracts, but substantial quantities were still being delivered under older, lower-priced contracts. Relatively stable spot prices prevailed between 1976 and 1979; delivery prices continued to rise as new contracts were negotiated at higher prices. In 1976, the US Energy Research and Development Administration (ERDA), formerly the AEC, began publishing the annual average price of uranium deliveries to US buyers. The average price in 1975 was published in 1976. Table 7 lists 1975 through 1983 average prices published annually by DOE (formerly ERDA and AEC).

Table 7

ANNUAL AVERAGE PRICE OF URANIUM DELIVERIES TO US BUYERS[1]
(US $ per pound U_3O_8)

Year	Average Price
Pre-1975	not reported
1975	10.50
1976	16.10
1977	19.75
1978	21.60
1979	23.85
1980	28.15
1981	32.20
1982	38.37
1983[2]	38.21
1984[3]	—

Source: "Survey of United States Marketing Activity." (US Department of Energy: published annually.)

[1] Includes all prices for delivered uranium, including long-term contracts previously negotiated and excluding prices of uranium not yet delivered, even though the price may have already been determined.

[2] Unadjusted price. Includes settlements of market-price contracts.

[3] Scheduled for release October 5, 1985.

Utility Involvement in Uranium Production

During the price rise of the 1974 to 1977 period, utility participation in exploration programs increased dramatically. Utilities were concerned about securing reliable fuel supplies, so many became active in production ventures, either through associations with exploration and mining companies or by acquiring independent facilities. Table 8 gives brief references to some of the ventures undertaken by utilities for uranium supply.

The utility participation in mining ventures further stimulated industry activity in this period, largely because of the additional financial support. ERDA records indicate that surface drilling increased to 34.2 million feet in 1976, with 16 mills operating at a capacity of 31,160 tons of ore per day. Two solution mines operated in 1976, adding approximately 1.2 million pounds U_3O_8 to the total production figure of 28 million pounds U_3O_8. However, only a few of the largest utilities achieved long-term success in their mining ventures of the mid-1970s and are still active today; many utilities abandoned projects in the late 1970s and early 1980s.

The Late 1970s

The effects of inflation forced ERDA to continue to make adjustments to in-place uranium resource estimates based on various cost categories. In doing so, the inflationary effects were reduced, but the actual resource base remained questionable. ERDA began to quantify resources based on the reduction of in-place ore grades, the inclusion of low-grade deposits, and the adoption of higher production costs. The AEC introduced the $10.00 cost category in 1971, the $15.00 category in 1972, the $30.00 category in 1973, the $50.00 category in 1977, and the $100.00 category in 1980. In addition, the $8.00 category established in 1947 was reclassified as the $15.00 category at the end of 1976.

Delays in nuclear power plant completion schedules, plant cancellations, and the lack of new plant orders began to affect the utilities by the end of 1975. The production industry, however, continued operating with apparent indifference to the changing attitudes of the utilities. Surface drilling increased to 40.5 million feet in 1977 and 47.0 million feet in 1978, the highest annual drilling rate ever. Over 100 production companies were active in this period, and 20 mills operated at a capacity of 43,810 tons of ore per day. Seven solution mines were in operation in the South Texas district and one in the Powder River Basin, Wyoming. In addition, projects to recover uranium from phosphoric acid were in operation at three Florida loca-

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RAW MATERIALS

Table 8

US ELECTRIC UTILITIES' PAST INVOLVEMENT IN URANIUM SUPPLY

(Partial summary compiled from published documents)

Arizona Public Service Company	Exploration in Date Creek, Arizona and Green Mountain, Wyoming areas. Bought Christensen Ranch property.
Baltimore Gas & Electric Company	With International Energy Corp. in Texas, and through an exploration joint venture in southern Wyoming with Philadelphia Electric Co., Pennsylvania Power & Light Co., and Public Service Electric & Gas Co.
Commonwealth Edison Company	Through its subsidiary companies: Cotter Corporation has a mine and mill operation and a crushing and sampling plant in Colorado. Nuclear Resources, Inc. was providing 90 percent of the funds for the Cleveland Cliffs Iron Co. and Getty Oil Co. exploration venture in the Powder River Basin, Wyoming. Commonwealth Edison also formed a joint venture with Wold Nuclear Company in the Red Desert, Wyoming area.
Consumers Power Company	Exploration and ore buying through its subsidiary, Plateau Resources, in Colorado and Utah. Mill in Shootaring Canyon in southeastern Utah. Plateau Resources also operated an exploration venture in southeastern Utah with Nuclear Dynamics and Frontier Resources.
Duke Power Company	Through its subsidary Western Fuel Inc. in unspecified areas.
Florida Power & Light Company	Exploration through a subsidiary, Fuel Supply Service, Inc., in joint venture with Getty Oil Co. in Colorado, Wyoming, and New Mexico.
Gulf States Utilities Company	Through a subsidiary, Varibus Corp., with Felmont Oil in Wyoming.
Houston Lighting & Power Company	Exploration in Wyoming through a subsidiary, Utility Fuels, Inc. Mining joint venture in Shirley Basin, Wyoming.
Kansas Gas & Electric Company *and* Kansas City Power & Light	Jointly formed Utilities Fuels Co., which had a mining venture with Cobb Nuclear in New Mexico.
Long Island Lighting Company	With Bokum Resources Corp. in New Mexico.
Niagara Mohawk Power Corporation	50 percent of a solution mining venture with U.S. Steel near Clay West, Texas.
Pacific Gas & Electric Company	Financing of a Texas solution mining project operated by Intercontinental Energy Co.
Pennsylvania Power & Light Company	Through its subsidiary URADCO. Joint venture with three other utilities in Wyoming.
Philadelphia Electric Company	Joint exploration venture in Wyoming with three other eastern utilities.
Portland General Electric Company	Prospecting in Wyoming, California, and Alaska. Development drilling in California.
Public Service Electric & Gas (New Jersey)	Through a joint venture with three other electric utilities. The utility had an arrangement to provide some of the advance financing to Kerr-McGee Corp. for a mining and milling operation in Wyoming. PSEG also had a joint exploration venture in Wyoming with Homestake Mining Co.
Southern California Edison Company	Joint venture partner in uranium exploration, mining, and milling activities of Rocky Mountain Energy, e.g., the Bear Creek mine and mill complex, north of Douglas, Wyoming. Another Wyoming mine and mill complex (Copper Mountain) which was planned to start up in 1982 or 1983 has been deferred indefinitely.
Texas Utilities Company	Through its subsidiary, Texas Utilities Fuel Co., had a joint exploration and development venture with Ranchers Exploration and Development Corporation in Colorado, Utah, Wyoming, and New Mexico.

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tions and from four heap leach operations in Colorado, Texas, and Utah. Production totaled 40.4 million pounds U_3O_8 in 1978, and in mid-1978 the Nuexco Exchange Value peaked at $43.40 per pound U_3O_8.

The uranium production industry's reactions to changes in the market were negligible in 1979. Exploration drilling declined slightly to 40.7 million feet, but 21 conventional mills operated at a capacity of 49,050 tons of ore per day, and total production reached 41.4 million pounds U_3O_8 in 1979. The Nuexco Exchange Value declined from $43.25 per pound U_3O_8 to $40.75 by the end of the year, the beginning of a decline that was to continue, except for brief interruptions, until the present.

Production in 1980 reached an all-time high of 46.6 million pounds U_3O_8 from 23 conventional mills, 11 solution mines, six phosphoric acid projects, and three heap leach operations. Nevertheless, rapidly declining uranium prices and utility announcements of further plant cancellations and delays triggered visible changes in the production industry. Exploration companies began to postpone and cancel projects, and exploration drilling fell to 27.8 million feet, 32 percent below the 1979 figure. The Nuexco Exchange Value fell to $27.00 by the end of the year. Many companies lacking high-priced delivery contracts were forced to abandon the uranium industry, and the exodus of 1981-1985 had begun.

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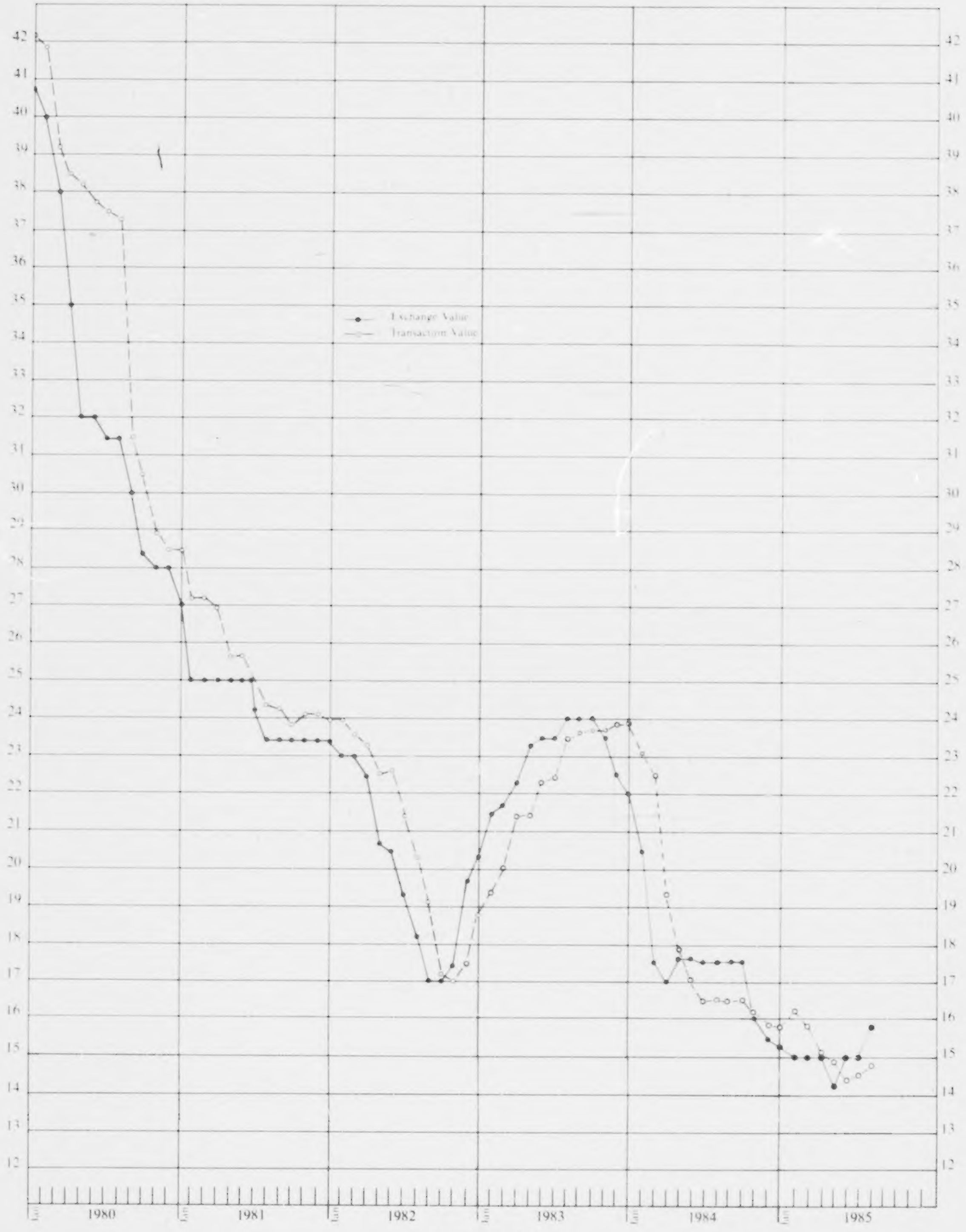
HISTORICAL MARKET DATA

EXCHANGE AND TRANSACTION VALUES
SINCE JANUARY 1980

Determined as of the last day of the month indicated



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HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	—	—	—	—	—	—	—	6.35	6.35	6.40	6.45	6.50
1969	—	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	32.50	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00
1981	25.00	25.00	25.00	25.00	25.00	24.25	23.50	23.50	23.50	23.50	23.50	23.50
1982	23.00	23.00	22.50	20.75	20.50	19.25	18.25	17.00	17.00	17.50	19.75	20.25
1983	21.50	21.75	22.25	23.25	23.50	23.50	24.00	24.00	24.00	23.50	22.50	22.00
1984	20.50	17.50	17.00	17.75	17.75	17.50	17.50	17.50	17.50	16.00	15.50	15.25
1985	15.00	15.00	15.00	14.25	15.00	15.00	**15.75**					

HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	—	—	—	—	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38.40	37.90	37.60	37.30	31.60	30.60	29.00	28.70	27.70
1981	27.20	27.20	27.00	25.70	25.70	24.50	24.40	24.30	23.90	24.10	24.10	24.00
1982	24.00	23.70	23.40	22.60	22.70	21.50	20.30	19.10	17.30	17.00	17.55	18.80
1983	19.35	20.00	21.35	21.40	22.35	22.45	23.50	23.60	23.65	23.65	23.85	23.85
1984	23.05	22.50	19.25	17.90	17.00	16.50	16.60	16.40	16.55	16.05	15.90	15.90
1985	16.20	15.70	15.05	14.90	14.45	14.60	**14.75**					

HISTORICAL CONVERSION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U as UF_6)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	1.20	1.20	1.20	1.40	1.15	1.15	1.15	1.10	1.10	1.10	1.20	1.20
1982	1.20	1.20	1.20	1.20	1.00	1.00	1.00	0.90	1.10	1.60	1.45	1.45
1983	1.20	1.40	1.40	1.20	1.20	1.20	1.10	1.10	1.00	0.60	0.60	0.60
1984	0.60	0.30	0.80	0.80	0.80	0.00	0.00	0.80	1.00	1.00	0.80	0.80
1985	1.00	1.00	1.00	1.50	1.50	1.60	**1.60**					

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AUSTRALIA

	Price Index of Materials Used in Manufacturing Industry—All Groups[1] (1969=100)	Award Rates of Pay Indexes Australia—Adult Males In Mining Wage and Salary Earners, Weekly Rates[2] (1976=100)
1983 Avg.	401.2	181.8
Jun 1984	404.7R	197.4
Jul 1984	408.3R	197.4
Aug 1984	413.1R	197.4
Sep 1984	411.9R	197.4
Oct 1984	408.4R	197.4
Nov 1984	407.1R	197.4
Dec 1984	405.9R	197.4
Jan 1985	409.3R	197.4
Feb 1985	416.0	197.4
Mar 1985	426.8R	197.4
Apr 1985	436.6	202.3
May 1985	—	202.3
Jun 1985	—	202.4

P = Preliminary R = Revised since last month

CANADA

	Industry Selling Price Index: Manufacturing[1] (1971=100)	Wage-earner Data: Average Hourly Earnings (C$)[2]					
		Uranium Mines (SIC 057)	Metal Mines* (SIC 051-059)	Mines, Quarries and Oil Wells[3] (SIC 051-099)	Primary Metal Industries Non-ferrous[4] (SIC 296)	Primary Metal Industries Non-ferrous[4] (SIC 298)	Chemicals and Chemical Products[5] (SIC 372-379)
1983 Avg.	298.8	—	—**	14.30	—	—	11.17
Aug 1984	312.7	17.24	15.36	14.92	12.44	10.34	11.78
Sep 1984	312.3	17.68	15.96	15.34	12.51	10.52	11.90
Oct 1984	312.3	17.64	16.15	15.26	12.69	10.56	11.96
Nov 1984	313.6	18.04	16.13	15.43	12.47	10.51	11.96
Dec 1984	314.2	17.95	16.39	15.60	12.16	10.40	11.99
Jan 1985	315.8	18.05	16.13	15.60	12.32	10.80	12.04
Feb 1985	316.4	18.78	16.41	15.68	12.54R	11.05	12.06
Mar 1985	317.9R	18.24	16.21	15.57R	12.43	10.97	12.02
Apr 1985	318.1	18.63	16.44R	15.80R	12.81R	11.23R	12.04R
May 1985	318.7	18.56P	16.44P	15.67P	12.86P	11.21P	12.15P
Jun 1985	318.9	—	—	—	—	—	—

P = Preliminary R = Revised since last month

For annual averages prior to 1983, and for notes pertaining to these statistics, see pages 23-26 of Report 190 of June 1984.

*The 1980 average for Metal Mines was incorrectly reported as 10.59. The correct average is 10.58 (see Report 190).

**Two different methods were used in the 1983 "Metal Mines" category in reporting survey data, and Statistics Canada did not publish a 1983 average. The March 1983 figure for the old method was 14.73 and for the new method was 14.84. The published average for 1983 in Report 190 was a Nuexco calculation based on the available monthly statistics for 1983 with the exception of the March figure, where only the 14.84 value was taken into account.

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REPUBLIC OF SOUTH AFRICA

	Average Declared Working Costs per per Metric Ton of Gold Ore Milled (Rand)[1]	Tonnage-Weighted Index of Average Working Costs per Metric Ton of Gold Ore Milled (March 1982=100)[2]	Consumer Price Index[3] (1975=100)[4]	Producer Price Index All Groups[5] (1975=100)	Total Employment in Mining and Quarrying (Code 35)[6]	Total Salaries and Wages in Mining and Quarrying (1,000 Rand) (Code 40)[6]
1983 Avg.	51.87	115.0	262.2	274.8	696,579	3,644,772
May 1984	—	—	288.3	292.6	710,040	327,937
Jun 1984	56.95	126.2	291.2	295.3	717,009	347,121
Jul 1984	—	—	295.1	296.0	717,121	369,964
Aug 1984	—	—	297.0	300.8	721,905	361,357
Sep 1984	60.64	133.2	299.9	304.1	721,470	359,218
Oct 1984	—	—	303.7	308.7	717,865	363,755
Nov 1984	—	—	307.4	312.8	717,396	369,771
Dec 1984	62.92	138.6	309.4	315.9	701,198	365,234
Jan 1985	—	—	177.1*	166.6*	711,366	376,777
Feb 1985	—	—	182.8*	171.3*	727,932	361,823
Mar 1985	64.48	142.4	183.6*	173.0*	708,809	371,380
Apr 1985	—	—	187.4*	174.0*	724,187	369,005
May 1985	—	—	189.5*	177.7*	—	—
Jun 1985	—	—	191.9*	—	—	—

*The basis for calculation for these indices has been revised to January 1980 = 100.

UNITED STATES

	Producer Price Index[1]		Consumer Price Index[2]	GNP Implicit Price Deflator[3]	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[4]			
	Industrial Commodities (1967=100)	All Commodities (1967=100)	(1967=100)	(1972=100)	Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)	Electric and Electronic Equipment (SIC 36)
1983 Avg.	315.8	303.1	298.4	215.63	12.57	13.43	10.59	8.65
May 1984	323.3	311.7	309.7	—	12.99	13.37	11.02	8.89
Jun 1984	323.9	311.4	310.7	222.40	12.96	13.40	11.03	8.91
Jul 1984	324.0	312.0	314.7	—	13.02	13.36	11.12	8.95
Aug 1984	323.5	310.9	313.0	—	13.10	13.51	11.13	9.00
Sep 1984	322.3	309.5	314.5	224.57	13.20	13.39	11.23	9.08
Oct 1984	323.2	309.4	315.3	—	13.23	13.53	11.32	9.09
Nov 1984	323.8	310.4	315.3	—	13.23	13.76	11.35	9.15
Dec 1984	323.0	309.9	315.5	226.10	13.28	13.66	11.37	9.27
Jan 1985	322.9	309.5	316.1	—	13.29	13.70	11.39	9.33
Feb 1985	322.5	309.2	317.4	—	13.30	13.73	11.39	9.33
Mar 1985	322.6	308.7	318.8	229.07R	13.29	13.95	11.37	9.39
Apr 1985	323.8	309.3	*320.1*	—	*13.43R*	*13.62R*	11.48R	9.40R
May 1985	325.3	309.9	321.3	—	13.24P	13.58P	11.46P	9.41P
Jun 1985	325.2	309.5	322.3	230.65	—	—	11.51P	9.47P

P = Preliminary R = Revised since last month

For annual averages prior to 1983, and for notes pertaining to these statistics, see pages 23-26 of Report 190 of June 1984.

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NUEXCO

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EXECUTIVE SUMMARY
REPORT 204
(All data as of July 31, 1985)

Exchange Value $15.75, up $0.75	The **Exchange Value** is **$15.75** per pound U_3O_8, up $0.75 since last month. Eight recent natural uranium sales are reported, involving approximately 1.8 million pounds U_3O_8 equivalent. Seven involved spot or near-term delivery, and four met the conditions for inclusion in the Transaction Value.
UF_6 Value $44.00, up $1.50	The **UF_6 Value** is **$44.00** per kilogram U as UF_6, up $1.50 since last month. Five transactions reported this month involved natural UF_6.
Supply-Demand Ratio rose to 6.7:1	Active spot and near-term **uranium supply** amounts to **3.0 million** pounds U_3O_8 equivalent, down 485 thousand pounds since last month. Active spot and near-term **uranium demand** totals **455 thousand** pounds, down 870 thousand pounds. The spot and near-term **supply-demand ratio** rose to **6.7:1.**
Transaction Value rose to $14.75	The **Transaction Value** is **$14.75** per pound U_3O_8, up $0.15 since last month. The calculation includes 17 transactions involving a total of 4.8 million pounds U_3O_8 and equivalent UF_6, and covers a period of 3 months.
Loan Use Charge Rate unchanged at 5%	The **Loan Use Charge Rate** is **5 percent** per annum, unchanged.
Conversion Value unchanged at $1.60	The **Conversion Value** is **$1.60** per pound U as UF_6, unchanged since last month. Active secondary market supply for conversion services for delivery within three years totals 360 thousand pounds U as UF_6. Active demand totals 425 thousand pounds U as UF_6.
SWU Values: $85 for DOE-origin for delivery by the end of FY86 $81 for non-DOE origin for delivery by the end of calendar year 1986	The **SWU Value** for DOE origin at .3 tails and certifiable as excess, is **$85** per SWU for delivery by the end of FY86. The SWU Value for other SWUs (non-DOE or non-certifiable) is **$81** per SWU for delivery by the end of calendar year 1986. Two secondary market SWU transactions are reported, involving less than 50 thousand SWUs.
Analysis & Commentary	DOE's incentive SWU pricing plan, whereby certain utilities can opt to purchase 30 percent of their requirements under the USEC at a base price of $90 per SWU, has no significant impact on the determination of a utility's optimum tails assay.
Australia	Energy Resources of Australia (ERA) released production figures for its Ranger mine for the fiscal year ending June 30, 1985.
Namibia	The Industrial Development Corporation of South Africa (IDC) recently transferred part of its ownership share in the Rossing mine to Namibia's transitional government, giving the South Africa-installed government the right to appoint one board member. However, the longer-term implications of the action will depend on the degree of legitimacy gained by the transitional government as a result of the economic power vested in the ownership shares.
South Africa	Second-quarter uranium production from Chamber of Mines producers amounted to 2.8 million pounds U_3O_8, down slightly from the first quarter.
Raw Materials	The US uranium industry, suffering rapidly declining production in the face of poor reserves and fierce foreign competition, may require government assistance to combat the effects of the past five years' mine closures and industry attrition.

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NUEXCO REPORT 204 FIGURES OF THE MONTH (July 31, 1985)	This Month (Report 204)	Last Month (Report 203)	12 Months Ago (Report 192)
Exchange Value[1]	15.75	15.00	17.50
Transaction Value[1]	14.75	14.60	16.60
UF_6 Value[2]	44.00	42.50	—
Loan Use Charge Rate[3]	5%	5%	6%
Conversion Value[4]	1.60	1.60	0.00
Near-Term Uranium Supply[5]	3.0	3.5	2.9
Near-Term Uranium Demand[6]	0.5	1.3	0.9
Near-Term Supply-Demand Ratio	6.7	2.7	3.1
Recent Uranium Sales:			
Number of Transactions[7]	8	8	6
Quantity of Material[8]	1.8	1.5	1.3
Nuexco SWU Values:[9]			
DOE origin, certifiable as excess, 0.3 tails assay; delivery before the end of FY86	85	88	—
Other SWUs (non-DOE or non-certifiable) delivery by the end of calendar year 1986	81	83	—
USDOE SWU Prices:			
USEC	135.00	135.00	135.00
AFC	153.00[10]	153.00[10]	153.00[10]
Requirements	157.00[10]	157.00[10]	157.00[10]
Market Value of Enriched UF_6[11] [12]:			
2.5 w/o U_{235}	455	452	513
3.0 w/o U_{235}	585	582	660
3.5 w/o U_{235}	717	714	810
4.0 w/o U_{235}	851	849	962

---

[1] US $ per pound U_3O_8 equivalent.

[2] US $ per kilogram U as UF_6.

[3] Per annum.

[4] US $ per pound U as UF_6.

[5] Active inquiries to sell, for delivery within 12 months after contract signing (millions of pounds U_3O_8).

[6] Active inquiries to purchase, for delivery within 12 months after contract signing (millions of pounds U_3O_8).

[7] Uranium sales only; does not include loans, conversion, or SWU

[8] Millions of pounds U_3O_8, equivalent.

[9] US $ per SWU.

[10] Effective 10/1/84.

[11] Calculated using the Nuexco Exchange Value, Conversion Value, and 0.30 percent tails assay. From 3/30/84 through 4/29/85, calculations used the Nuexco SWU Value for DOE origin and FY85 delivery. As of 4/30/85, calculations use the Nuexco SWU Value for DOE origin and delivery by the end of FY86.

[12] US $ per KgU as UF_6, rounded to the nearest $.

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SEPTEMBER 1985 NUMBER 205

MONTHLY REPORT

ON THE NUCLEAR FUEL MARKET

NUEXCO

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MONTHLY REPORT ON THE NUCLEAR FUEL MARKET

September 1985 No. 205

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To Our Readers

Nuexco will host a hospitality suite during the Atomic Industrial Forum's Uranium Seminar in Santa Fe, New Mexico. The suite will be located at the La Fonda Hotel, September 29 October 2. We look forward to seeing you there.

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NATURAL URANIUM AND SECONDARY MARKET CONVERSION

(All data as of August 31, 1985)

The **Exchange Value** is **$16.00** per pound U_3O_8, up $0.25 since last month. **Active supply** of natural uranium (U_3O_8 and UF_6) for spot or near-term delivery totals **3,340,000** pounds equivalent U_3O_8 as concentrates or UF_6, up 305,000 pounds since last month. The corresponding figure for **active demand** is **1,205,000** pounds, up 750,000 pounds. The spot and near-term **supply-demand ratio** fell to 2.8:1.

The *Current Market Data* section of this Report lists three natural uranium sales transactions, involving a total of approximately 400,000 pounds U_3O_8 equivalent. All of the transactions reported this month involved deliveries in the near term, and also met the criteria for inclusion in the current Transaction Value calculation.

The **UF_6 Value** is **$44.50** per kilogram U in UF_6, up $0.50 since last month. One of the transactions reported this month involved UF_6.

The **Transaction Value** is **$15.10** per pound U_3O_8, up $0.35 since last month. The current Transaction Value includes 14 transactions involving a total of 2.4 million pounds U_3O_8 or equivalent UF_6 and covers a period of 3 months.

The **Loan Use Charge Rate** is unchanged at **5 percent** per annum.

* * *

The market for natural uranium firmed somewhat in this relatively quiet month, and the Exchange Value rose slightly to $16.00; three sales took place at prices approximately equal to that level. Recent bids and offers continued to reflect the buyers' and sellers' perception of market firming. While demand increased this month, buyers are still content to wait for attractive opportunities to appear, rather than feeling pressure to buy on a certain schedule. The prevailing perception among sellers that a gradual price rise is underway has been reflected in gradually rising offers.

In Europe, the customary summer vacation period inhibited activity. Moreover, the continuing decline of the US dollar generally resulted in little real change in either the Exchange Value or UF_6 Value as expressed in European currencies. Six to ten months ago the US dollar was rising steadily against most currencies, and had set new records against the French franc, West German mark, and Italian lira. Recent fears that the US economy is stagnating, however, have contributed to a sharp decline in the dollar's value overseas in the last several months. Since late February, the dollar's value has declined 25 percent against the British pound, 14 percent against the lira, and 18 percent against the franc. Lowering interest rates for the past five months have discouraged foreign investment in the USA, driving down the value of US currency.

* * *

The UF_6 Value also rose in conjunction with the Exchange Value, but at a slower rate. The preponderance of UF_6 offered in the market in the last few months has diminished slightly, and the UF_6 Value remains just below the algebraic sum of the Exchange and Conversion Values. In addition, the buyer preference for UF_6 appears to have waned compared to recent months, and seems to be shifting back toward concentrates somewhat.

* * *

The **Conversion Value** is **$1.60** per pound U in UF_6, unchanged since last month. The secondary conversion market has remained basically unchanged over the last several months, and the few secondary market transactions occurring generally have involved small quantities. These transactions often are utilized to complete deconversion swaps or as related parts of larger deals. One conversion transaction, involving less than 50,000 pounds U as UF_6, is reported. Active supply of secondary market conversion services for delivery within three years totals 325,000 pounds U as UF_6. Active secondary market demand for conversion amounts to 525,000 pounds U in UF_6.

ENRICHED URANIUM AND SWUS

The Nuexco **SWU Values** as of August 31, 1985 are:

1. For **DOE origin**, a tails assay of 0.30 weight-percent U_{235}, for delivery by the end of FY86, and certifiable as excess, $85 per SWU, unchanged.
2. For **other** SWUs (includes DOE origin SWUs not certifiable as excess and non-DOE origin SWUs), for delivery by the end of calendar year 1986, $81 per SWU, unchanged.

One secondary market SWU transaction is reported, involving less than 50 thousand SWUs.

* * *

A lack of activity in the markets for SWU of either origin continued throughout August. Notably absent this month was a bargain-priced opportunity similar to those that have appeared one at a time in recent months. Each time this type of opportunity arose, competition for the

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sale served to drive down prices. Without the competition stemming from presence of a firm buyer, there was little downward pressure on prices. Conversely, the lack of a number of interested buyers entering the market at the same time for either type of SWUs resulted in no upward price movement.

* * *

DOE sent a letter to its customers on September 4 informing them of the price for enrichment services in 1986. For USEC customers, the fiscal year 1986 price is $125 per SWU, a seven-percent decline from the 1985 price. The new price will take effect October 1, 1985. In addition, DOE has set a "high assay charge" of $492 per SWU for enrichments of 10 weight/percent (w/o) or greater, effective April 1, 1986.

Since a customer taking high-enriched uranium from DOE would pay $492 per SWU for each SWU taken over 10 w/o, the *weighted average price* paid for enrichment services contained in the product would vary according to the assay. Using a 0.2 w/o tails assay, the price per SWU for 20 w/o product should be around $154 per SWU. For 93 w/o material, the weighted average price is calculated to be slightly greater than $184 per SWU. DOE sources have not been able to verify these price estimates, indicating that their interpretation of how the weighted average price is calculated may differ significantly from Nuexco's.

* * *

DOE has disclosed its long-term enrichment strategy, which includes a target price of $60 per SWU in the year 2000, in a meeting with non-US utilities. DOE representatives held a uranium enrichment seminar in July 1985, during which some of the issues of the enrichment program were covered, as summarized below.

Enrichment cost reductions—The present price of $135 per SWU will be reduced to $125 per SWU for fiscal year 1986. The price may be reduced further to $115 per SWU, competitive with European enrichers, within four years. Throughout the 1990s, according to DOE, the price may be reduced to a level unrivaled by any competitors, culminating in a $60 per SWU price in the year 2000.

Future of Diffusion Plants—DOE predicts that a $250 million cost reduction will be accomplished over the years 1986 to 1991 at the two operating gaseous diffusion plants at Paducah, Kentucky and Portsmouth, Ohio. DOE plans to improve the economic efficiency of the plants by utilizing off-peak electricity for 50 percent of the total power demand. Finally, the Oak Ridge, Tennessee plant, which will be placed on standby as a cost-cutting measure, will resume production if the demand exceeds 14,000 metric tons enriched UF_6.

Selection of AVLIS—Some of the rationale DOE presented to justify its decision to proceed with the development of Atomic Vapor Laser Isotope Separation (AVLIS) as the future US enrichment technology, are:

1. The potential for reductions in production costs is high.
2. The amount of investment required for AVLIS, supposedly no more than $3 billion, may be half as much as that required to fund an advanced gas centrifuge plant.
3. A small-scale AVLIS plant can run as efficiently as a large-scale plant.

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CURRENT MARKET DATA

August 31, 1985	Market Values	Active Supply[1] (thousands)	Active Demand[1] (thousands)
EXCHANGE VALUE	**$16.00**/lb. U_3O_8	3,340	1,205
UF_6 VALUE	**$44.50**/kgU		
CONVERSION VALUE	**$1.60**/lb. U as UF_6	325	525
SWU VALUES			
DOE origin, certifiable as excess, 0.3 tails assay delivery by the end of FY86	**$85**/SWU		
Other SWUs (non-DOE or non-certifiable) delivery by the end of calendar year 1986	**$81**/SWU		
LOAN USE CHARGE RATE	5%/annum	2,800	500

TRANSACTION VALUE

$/lb. U_3O_8	Millions of Pounds	Number of Transactions	Number of Months
15.10	2.4	14	3

DEFINITIONS

1. The **Exchange Value** is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the date indicated.
2. The **UF_6 Value** is Nuexco's judgment of the price at which spot and near-term transactions for significant quantities of natural uranium hexafluoride could be concluded as of the date indicated.
3. The **Conversion Value** is Nuexco's judgment of the price at which spot and near-term transactions for significant quantities of conversion services could be concluded in the secondary market as of the date indicated.
4. The **SWU Values** represent Nuexco's judgment of the price at which transactions for the sale of significant quantities of SWUs of stated origin for delivery in the specified time period could be concluded as of the date indicated.
5. The **Loan Use Charge Rate** is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the date indicated.
6. The **Transaction Value** is a weighted average price of recent natural uranium sales transactions. The calculation is based on prices paid in:
   a. Transactions closed within the previous three-month period for which delivery is scheduled within one year of the transaction date;
   b. At least ten transactions;
   c. Transactions involving a sum total of at least 2 million pounds U_3O_8 equivalent.

The sample time is extended as necessary to include these minima. Other currencies are converted to US dollars using conversion rates in effect on or near the transaction date.

DERIVATIONS AND COMMENTS

1. All Market Values are based on:
   a. Data from recently completed transactions.
   b. Data from pending transactions.
   c. Firm bids to buy or borrow, and firm offers to sell or lend.
   d. Prices purchasers or rates borrowers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy or borrow, and prices sellers or rates lenders have expressed a willingness to offer, but for which Nuexco is not aware of firm offers to sell or lend.
2. Prices associated with deliveries under old or renegotiated contracts or other than arm's-length transactions are not considered in the determination of these Market Values.
3. In the determination of the Conversion Value, Nuexco does not consider transportation charges other than those customarily provided by primary suppliers of conversion services.
4. The prices of conversion services or SWUs delivered under long-term contracts with primary suppliers are not considered in the determination of either the Conversion Value or SWU Value.
5. For the DOE SWU Values, Nuexco converts SWU prices at varying tails and product assays to equivalent SWU prices at a tails assay of 0.30 weight-percent U_{235} and a product assay of 3.0 weight-percent U_{235}, assuming feed costs corresponding to the Nuexco Exchange and Conversion Values determined as of the same date.
6. In calculating the Transaction Value, Nuexco does not account for the price of uranium delivered in connection with contracts which call for "market price" mechanisms. This exclusion applies particularly to contracts in which delivery prices are expressed as a function of future Exchange Values or any other indeterminant variable. Also excluded from the calculation are any other transactions in which the delivery price is defined in such a way that it cannot currently be determined.

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[1] Supply and demand tables in the *Current Market Data* section of this Report detail the numbers for each category.

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CURRENT MARKET DATA

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

	per lb. U_3O_8 in Concentrates			per kg. U in Concentrates		
Country (currency)	This Month (Aug. 31, 1985)	Last Month (July 31, 1985)	12 Months Ago (Aug. 31, 1984)	This Month (Aug. 31, 1985)	Last Month (July 31, 1985)	12 Months Ago (Aug. 31, 1984)
Australia (dollar)	22.74	21.82	20.60	59.13	56.74	53.56
Belgium (comm. franc)	899.89	893.87	1,018	2,339	2,324	2,647
Canada (dollar)	21.78	21.29	22.71	56.63	55.35	59.03
Finland (markka)	94.45	93.14	105.87	245.55	242.14	275.23
France (franc)	135.82	135.43	154.87	353.11	352.08	402.62
FRG (mark)	44.46	44.50	50.49	115.58	115.70	131.26
Italy (lira)	29,840	29,689	31,418	77,576	77,185	81,681
Japan (yen)	3,793	3,739	4,220	9,862	9,721	10,971
Netherlands (guilder)	50.09	49.81	56.91	130.22	129.50	147.95
South Africa (rand)	45.71	32.21	27.34	118.85	83.74	71.09
Spain (peseta)	2,613	2,579	2,884	6,795	6,705	7,498
Sweden (krona)	132.45	130.38	145.11	344.34	338.96	377.25
Switzerland (franc)	36.45	36.33	41.96	94.77	94.46	109.08
UK (pound)	11.43	11.11	13.34	29.72	28.89	34.68
US (dollar)	16.00	15.75	17.50	41.60	40.95	45.50

TRANSACTION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

	per lb. U_3O_8 in Concentrates			per kg. U in Concentrates		
Country (currency)	This Month (Aug. 31, 1985)	Last Month (July 31, 1985)	12 Months Ago (Aug. 31, 1984)	This Month (Aug. 31, 1985)	Last Month (July 31, 1985)	12 Months Ago (Aug. 31, 1984)
Australia (dollar)	21.46	20.44	19.31	55.80	53.13	50.19
Belgium (comm. franc)	849.27	837.12	954.04	2,208	2,176	2,480
Canada (dollar)	20.56	19.94	21.28	53.45	51.83	55.32
Finland (markka)	89.14	87.23	99.21	231.74	226.77	257.93
France (franc)	128.18	126.83	145.13	333.25	329.72	377.31
FRG (mark)	41.96	41.68	47.32	109.08	108.35	123.01
Italy (lira)	28,161	27,804	29,443	73,213	72,284	76,546
Japan (yen)	3,580	3,502	3,955	9,307	9,104	10,281
Netherlands (guilder)	47.27	46.65	53.33	122.89	121.27	138.65
South Africa (rand)	43.14	30.16	25.63	112.16	78.42	66.62
Spain (peseta)	2,466	2,415	2,703	6,412	6,279	7,026
Sweden (krona)	125.00	122.10	135.99	324.97	317.44	353.54
Switzerland (franc)	34.40	34.03	39.32	89.44	88.46	102.22
UK (pound)	10.79	10.41	12.50	28.05	27.05	32.50
US (dollar)	15.10	14.75	16.40	39.26	38.35	42.64

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[1] Calculated using currency exchange rates published in the *Wall Street Journal* on August 30, 1985.

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CONVERSION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

	per lb. U as UF_6			per kg. U as UF_6		
Country (currency)	**This Month (Aug. 31, 1985)**	**Last Month (July 31, 1985)**	**12 Months Ago (Aug. 31, 1984)**	**This Month (Aug. 31, 1985)**	**Last Month (July 31, 1985)**	**12 Months Ago (Aug. 31, 1984)**
Australia (dollar)	2.27	2.22	0.94	5.01	4.89	2.08
Belgium (comm. franc)	89.99	90.81	46.54	198.39	200.19	102.60
Canada (dollar)	2.18	2.16	1.04	4.80	4.77	2.29
Finland (markka)	9.45	9.46	4.84	20.82	20.86	10.67
France (franc)	13.58	13.76	7.08	29.94	30.33	15.61
FRG (mark)	4.45	4.52	2.31	9.80	9.97	5.09
Italy (lira)	2,984	3,016	1,436	6,578	6,649	3,166
Japan (yen)	379.33	379.87	192.91	836.27	837.46	425.29
Netherlands (guilder)	5.01	5.06	2.60	11.04	11.16	5.74
South Africa (rand)	4.57	3.27	1.25	10.08	7.21	2.76
Spain (peseta)	261.35	261.99	131.84	576.18	577.60	290.66
Sweden (krona)	13.25	13.25	6.63	29.20	29.20	14.62
Switzerland (franc)	3.65	3.69	1.92	8.04	8.14	4.23
UK (pound)	1.14	1.13	0.61	2.52	2.49	1.34
US (dollar)	1.60	1.60	0.80	3.53	3.53	1.76

SWU VALUES AND UF_6 VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	**DOE SWU Delivery by the End of FY86 (August 31, 1985)**	**Non-DOE SWU Delivery by the End of CY86 (August 31, 1985)**	**UF_6 Value per kg. U in UF_6 This Month (August 31, 1985)**	**UF_6 Value per kg. U in UF_6 Last Month (July 31, 1985)**
Australia (dollar)	120.82	115.14	63.26	60.97
Belgium (comm. franc)	4,781	4,556	2,503	2,497
Canada (dollar)	115.73	110.28	60.59	59.48
Finland (markka)	501.77	478.16	262.69	260.20
France (franc)	721.56	687.61	377.76	378.33
FRG (mark)	236.18	225.06	123.65	124.33
Italy (lira)	158,523	151,063	82,991	82,941
Japan (yen)	20,152	19,203	10,550	10,446
Netherlands (guilder)	266.09	253.57	139.31	139.15
South Africa (rand)	242.86	231.43	127.14	89.98
Spain (peseta)	13,884	13,231	7,269	7,205
Sweden (krona)	703.64	670.53	368.38	364.24
Switzerland (franc)	193.67	184.55	101.39	101.50
UK (pound)	60.74	57.88	31.80	31.04
US (dollar)	85.00	81.00	44.50	44.00

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[1] Calculated using currency exchange rates published in the *Wall Street Journal* on August 30, 1985.

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CURRENT MARKET DATA

RECENT TRANSACTIONS[1]

Uranium Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U_3O_8 equivalent)	Approximate Price as Percent of Current Exchange or UF_6 Value	Seller	Buyer	Remarks
3544	1985	50-100	99	US Producer	Trader	
3539	1985	50-100	100	US Producer	US Utility	
3512	1985-1986	101-300	99	Canadian Producer	US Utility	UF_6.

Secondary Market Conversion Services

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U equivalent)	Approximate Price as Percent of Current C.V.	Seller	Buyer	Remarks
3547	1985	less than 50	96	US Utility	US Utility	

Enrichment Services
Secondary Market Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity[2] (thousands of SWUs)	Approximate Price[3] as Percent of Current SWU Value[4]	Seller Group	Buyer Group	SWU Origin	Remarks
3508	1986	less than 50	less than 100	Trader	US Utility	DOE	0.2 percent tails assay.

[1] Transactions listed are not limited to those in which Nuexco was involved, but also include others of which Nuexco is aware.

[2] If tails assay is unknown or unspecified, Nuexco's calculation of SWU quantity assumes 0.30 w/o tails assay.

[3] Price is not normalized to 0.30% tails assay.

[4] Refers to SWU Value that corresponds to SWUs included in transaction. When prices and SWU values are expressed as discounts (e.g., X dollars less than DOE's USEC base price at time of delivery), the percentage refers to the ratio of the *discounts*, not the ratio of the prices.

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URANIUM SUPPLY
(August 31, 1985)

	Delivery Period[1] (Thousands of Pounds U_3O_8)		
Nuexco Project Number	**Spot or Near-term[2]**	**Intermediate or Long-term**	**Remarks**
Available for Sale:			
ACTIVE			
2389*	350	—	
2623*	1,000	1,000	
2654	500	500 per year	UF_6
2804*	100	—	
2668*	50	—	UF_6
2705A	200	—	UF_6
2711*	80	—	
2728	200	500 per year	1986-90
2736*	80	—	
2746	180	—	UF_6
2774*	100	—	
2814	500	500	UF_6
2625	—	250 per year	1987-89
2680	—	250 per year	1986-92
TOTAL:	3,340		
INACTIVE			
1860*	250	1,000 per year	UF_6
2191	125	—	UF_6
2335*	275	—	
2336	250	250 per year	1985-94
2483*	545	—	
2553	300	—	
2297	—	200 per year	1986-89
TOTAL:	1,745		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2134.

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CURRENT MARKET DATA

URANIUM DEMAND
(August 31, 1985)

	Delivery Period[1] (Thousands of Pounds U_3O_8)		
Nuexco Project Number	**Spot or Near-term[2]**	**Intermediate or Long-term**	**Remarks**
Inquiries to Purchase:			
ACTIVE			
2590	75	—	U_3O_8 or UF_6
2681*	500	1,500	UF_6 or U_3O_8; 1987-88
2757	130	—	UF_6
2767*	200	—	UF_6
2775*	200	—	
2784*	100	—	
2217	—	1,000 per year	1989-95
2507	—	600	1987-89
2741	—	600	
2758	—	500	UF_6
TOTAL:	1,205		
INACTIVE			
2548	290	—	
2576	20	—	UF_6
2636	100	—	
2718	250	350	
2414	—	175	
2586*	—	600	1986-90
2643	—	150 per year	1987 on
2694	—	625	1987; UF_6
TOTAL:	660		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2676.

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LOAN SUPPLY AND DEMAND
(August 31, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Within 1 Year	Beyond 1 Year	Remarks
Available for Loan: ACTIVE			
1938*	2,000	—	UF_6
2469A*	800	—	
TOTAL:	2,800		
Available for Loan: INACTIVE			
2036	500	—	
2483	550	—	
2667	800	—	
TOTAL:	1,850		
Inquiries to Borrow: ACTIVE			
2606*	500	—	
TOTAL:	500		

*New or revised since last month.
[1] Measured from the date of this Report.
Projects removed since last month: None.

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CONVERSION SUPPLY AND DEMAND
(August 31, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U as UF₆) Within 3 Years	Beyond 3 Years	Remarks
Available for Sale:			
ACTIVE			
2511	—	300	1986-90
2725*	325	—	
TOTAL:	325		
Inquiries to Purchase:			
ACTIVE			
2596*	250	—	
2617	275	420	1986-91
TOTAL:	525		
INACTIVE			
2529	225	—	
2724	—	375	1989-93
TOTAL:	225		

*New or revised since last month.
[1] Measured from the date of this Report.
Projects removed since last month: 2587, 2709.

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CURRENT MARKET DATA

SWU SUPPLY AND DEMAND
(August 31, 1985)

	Delivery Period[1] (Thousands of SWUs)		
Nuexco Project Number	Spot or Near-term[2]	Intermediate or Long-term	Remarks
Available for Sale:			
ACTIVE			
2410*	350	—	
2607	200	—	
2624	100	—	
2684*	35	—	
2705*	100	—	
2571	—	55	1987
TOTAL:	785		
INACTIVE			
2359	—	200	
2378	—	120	1988
2510*	—	50	
2652	—	25	1986
TOTAL:	0		
Inquiries to Purchase:			
ACTIVE			
2400	—	150	1987-90
2519	—	30 per year	1987 on
2578	115	—	
2597*	—	30	
2668	—	15	
2742*	15	—	
2747	30	50	1987 on
TOTAL:	160		
INACTIVE			
2500	—	170	1988
2512	—	15 per year	1987 on
2595	—	50	1986
TOTAL:	0		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes SWUs deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2693, 2706.

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SOUTH AFRICA

Introduction

As the political and social turmoil continues in South Africa, relations with other nations worldwide have begun to suffer and, more importantly, South Africa's economy has begun to lose the confidence and support of the international banking community. The sense of crisis has deepened in the wake of escalating racial violence, declining currency values, the imposition of emergency financial controls, and the withdrawal of credit by international banks. The possibility of international trade sanctions, however symbolic, and the recently suspended mineworkers' strike have drawn a great deal of attention, but the key to this situation lies in its effect on the nation's economy. The pressure from the international banking community could accomplish what external political pressure could not achieve, a peaceful dismantling of apartheid. Nevertheless, the large stockpiles held by producers will keep uranium supply channels open for the foreseeable future. Even if a black majority government takes power in South Africa, the nation earns half of its foreign exchange revenue from gold, so gold mining operations, and therefore uranium production, will certainly continue.

Civil Unrest

A government-declared state of emergency, covering many black townships and granting broad arrest powers to police, took effect in late July. It was designed to curb the violence, but instead the crisis has grown into the country's worst in more than twenty-five years. The declaration of a state of emergency in 36 magisterial districts around Johannesburg and in the Eastern Cape, combined with rioting in black townships, and State President P. W. Botha's ruling National Party's refusal to negotiate with leaders recognized by black South Africans, have led to increased worldwide denunciation of apartheid.

In mid-August, speculation abounded that Botha would announce unprecedented reforms as a response to rising internal and external pressures, both political and economic. Rumors reinforced by South African officials heightened the optimism that preceded Botha's speech. However, the August 15 speech, presented at the Natal provincial congress of the National Party, disappointed many with its harsh tone and uncompromising message. Botha's vague references to the prospect of unspecified future constitutional discussions involving "all South African citizens," disappointed expectant world observers. In fact, because the country's 24 million blacks are presently denied the rights of citizenship, Botha's remarks could be interpreted as having promised nothing at all. Stressing defiance far more than plans for reforms, Botha issued a blunt warning that foreign governments pressing Pretoria to change need not expect their efforts to bear fruit any time in the near future.

Mineworkers' Strike

Members of the National Union of Mineworkers (NUM), the largest and most powerful black trade union, on September 1 struck gold, uranium, and coal mines owned by three of the six South African mining houses. The NUM had announced that 60,000 would strike, but later acknowledged that fewer than expected had done so. The Chamber of Mines claimed that only 14,000 struck, but the NUM claimed 28,000 strikers (6,000 at mines where a strike had been declared and 22,000 at others where union members had stopped work in support of the main strikes). The only uranium mines affected were Hartebeestfontein and Driefontein.

The workers struck over economic issues, but they also made two other demands that constituted a political threat to the Botha government.

1. They wanted authorities to end the state of emergency that had been declared in 36 magisterial districts.
2. They wanted to government to drop its threat to "repatriate" (deport) black mineworkers in retaliation for any international sanctions imposed against South Africa.

The increasingly militant union, created three years ago and headed by general secretary Cyril Ramaphosa, claims a dues-paying membership of 150,000. Ramaphosa called the strike after Gold Fields, Gencor (General Mining Corporation), and Anglo-Vaal refused to meet NUM demands for a 22-percent across-the-board pay increase. The mining companies had offered 14-percent to 19-percent pay increases for various categories of workers. Three other companies reached agreement with the union over pay increases—Rand Mines, Johannesburg Consolidated Investments (JCI), and Anglo American Corporation. (The greatest union membership is at Anglo American Mines.)

South African legislation (the Mines and Works Act) contains definitions of "scheduled persons" affecting 13 categories of workers. By requiring special certification for those jobs (from underground blasting to driving winding engines to mine manager) and, by denying that certification to blacks, the government has maintained a *de facto* segregation known by the apartheid code-phrase, "job reservation." Although only two percent of the total

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jobs are technically included in these reserved categories, they represent job security for about 30 percent of the industry's white workers. Furthermore, the existence of government-imposed distinctions among workers, rather than market-determined distinctions, has had the effect of artificially depressing blacks' wages. White *miners* typically receive more pay than their black *mineworker* counterparts. The NUM claims that differential is typically a ratio of 6 to 1; the Chamber of Mines resists such a generalization, preferring instead to concentrate on the large percentage gains made by blacks relative to whites over the past 5 to 10 years. The South African government had announced in 1981 its intention to repeal the job reservation legislation, subject to agreement between the Chamber of Mines and the white unions on certain conditions for job security. In May 1985, however, the Minister of Mineral and Energy Affairs announced that the government would enact the necessary legislation in the next session of parliament, whether or not that agreement had been reached. If that takes place, the wage differential should diminish even more rapidly than heretofore. However, the Botha government's response to the current crisis has raised doubts about when, if ever, the government will allow such a move.

From the outset, observers generally thought that the strike would be short in duration, partly because of the union's lack of resources to sustain its members while on strike. That expectation was borne out after only three days, when the NUM suspended the strike after 5,000 of its members were fired. The mass firing by Gold Fields of South Africa, Ltd., clearly broke the strike. That tactic has been used before and was anticipated (and feared) by the union. Even after the strike had been suspended, Gencor announced its intention to fire another 900 blacks (of a total of 1,100) at its Marievale gold mine in retaliation for their having taken part in the strike. Although the strike had severely disrupted mining operations, the processing of stockpiled ore allowed for the continuance of full output. The mining companies decisively won this first round. The striking mineworkers did achieve one small success, however. They managed for the first time to break the solid front that had been presented by the mining companies and won some larger pay increases as a result. But in the process, they found themselves maneuvered into striking the mines where the union was weakest and against companies that had taken the hardest line in negotiations.

While seeking to standardize pay offers to black employees through the Chamber of Mines, mining companies historically have presented a united front to the union. That unity was broken when Anglo American Corp. improved on the Chamber's initial offer to the union and Rand Mines and JCI quickly followed suit by matching Anglo American's offer of pay increases ranging from 17 to 22 percent, with increased leave allowances. Thus, strikes occurred only at Driefontein (operated by Gold Fields), Hartebeestfontein (operated by Anglo-Vaal), and Marievale (operated by Gencor).

Urging its members to return to work, the union's executive council gave three reasons for its latest action:

1. To save members' jobs;
2. To prevent further violence at the mines;
3. To challenge in court the companies' right under South African labor law to dismiss strikers.

The union also said it would seek a court injunction to prevent management from deporting the dismissed workers. Under South African law, 97 percent of the country's black mineworkers must be migrant workers from neighboring countries or so-called tribal homelands (areas to which they have been assigned under the apartheid laws). The union also charged that the three mining companies by their actions were attempting to break the union as well as the strike. For example, mine security forces had arrested more than 120 union supporters on charges of intimidating and harassing miners reporting to work. Union leaders countered with charges that violent intimidation by employers had caused the lower than expected strike participation. Independent verification of those conflicting claims was not possible because the mining companies closed their properties to reporters.

External Pressure

Botha's August 15 speech appeared to strengthen international opposition to apartheid and to the policies of the South African government. Demonstrating the degree of their concern, the European Community nations[1] pointedly recalled their respective ambassadors for "consultation" in late August. In keeping with the EC member nations' general aversion to the use of unilaterally imposed trade sanctions, they held a joint meeting in Luxembourg to facilitate the formulation of a unified response to the South African situation. They then designated the foreign ministers of Italy, Luxembourg, and the Netherlands as representatives from the Community as a whole, and delegated them to return to South Africa on a fact-finding mission. The EC delegation met with President Botha and other officials on August 31, and later recommended that the EC forego the imposition of economic sanctions against South Africa, at least temporarily. The EC has since adopted the recommendation of the delegation. The guiding philosophy appears to be that economic disengagement would only exacerbate South Africa's problems, and that the EC offers the most effective mechanism for the handling of trade matters. However, France did take some independent action when the Prime Minister announced a government prohibition on new investment in South Africa.

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[1] Belgium, Denmark, France, FRG, Greece, Ireland, Italy, Luxembourg, Netherlands, and the UK.

In the USA, mounting Congressional pressure soon will force President Reagan to make a decision regarding the US response to the South African situation. While the President continues to support the policy of "constructive engagement" (persuasion toward reform rather than overt political and economic pressure), members of Congress have been urging Reagan to accept a compromise bill containing limited economic sanctions. The bill came about as a result of an agreement reached by Senate and House conferees several weeks ago. If enacted, the bill would prohibit exports of nuclear goods and technology to South Africa. That provision would be moot, however, since such exports are already forbidden by virtue of the fact that South Africa has not signed the Nuclear Nonproliferation Treaty.

As late as September 1, Reagan threatened to veto any bill containing sanctions, saying that it would hurt South Africa's blacks most. However, as it has become clear that there is enough Congressional support for the bill to override a Reagan veto, it now appears that Reagan will impose economic sanctions by means of an executive order. The executive action, like the compromise bill, would ban the sale of Krugerrand gold coins, prohibit most new US government loans to South Africa, and halt the sale of computer equipment used to enforce apartheid policies. Also like the compromise bill, Reagan's executive order would prohibit shipments of nuclear equipment or technology until South Africa agrees to the Nuclear Nonproliferation Treaty.*

While the proposed compromise legislation would allow the President to recommend to Congress further sanctions if South Africa does not take measures within one year to dismantle apartheid, Reagan's executive order would no doubt modify that stance and allow more time for changes. Moreover, *any* sanctions, whether imposed via an executive order or a legislative act, would not apply to existing contracts.

Switzerland and Sweden, which are not members of the EC, have been making their policies independently for some time. A strict Swedish government policy dating back to January 1984 prohibits utilities from buying South African uranium. Switzerland has prohibited arms exports to South Africa since the 1970s, but in general does not participate in sanctions.

In Canada, the government has ordered Eldorado Nuclear Ltd. to make no more agreements to convert "Namibian uranium imported from South Africa." The government will honor existing contracts and presumably would cancel the restriction if South Africa accepted the United Nations plans for Namibian independence.

Australia announced economic sanctions against South Africa, including a freeze on investments and a ban on weapons imports, although it did not sever diplomatic relations with Pretoria. Australian Prime Minister Hawke's cabinet issued a detailed report following the Botha speech, noting that the sanctions would not amount to a total trade embargo. However, the sanctions will ban exports of oil and petroleum products, computer hardware, and other products which would be of use to South African security forces. In addition, the import of Krugerrand gold coins and South African military equipment will be prohibited, and direct investment, either into South Africa by the Australian government or vice versa, also will be prohibited. Australian officials had decided on the sanctions before Botha's address, but had delayed implementation in the hope that he might make some concessions to blacks in his August 15 speech. In any event, the Australian sanctions will have little practical effect, as South Africa and Australia do not trade extensively with each other.

Economic Effects

Earlier this year, the South African economy seemed to be emerging from three years of deep recession. But just as interest rates were dropping and economic activity was increasing, the escalation of racial violence caused foreign investors to become anxious about the security of South African investments. Foreign bankers refused to extend the deadline for repayment of South Africa's international debt. The total amount was $17 billion, of which $12 billion is short-term.

The reextension of those loans had become routine, so the resulting sudden demand for large quantities of dollars sent the rand tumbling to its lowest level in history against the US dollar, $0.35. At the end of August, South Africa suspended trading on the country's stock and currency exchanges. According to Finance Minister Barend

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*President Reagan signed the Executive Order on September 9, 1985.

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du Plessis, the steps were taken to enable South Africa to "continue to meet all international obligations." The governor of South Africa's central bank reported that 5.6 billion more rand had left the country in the last 18 months than had entered. Since a state of emergency was declared in 36 magisterial districts on July 20, the rand has lost almost one-fourth of its value against the dollar.

Several days after the suspension of trading took effect, Finance Minister du Plessis announced a freeze on repayments of principal on the country's $17 billion in foreign debt and the reintroduction of the two-tier financial rand exchange market applicable to foreign investments. The rand then recovered to $0.45. The freeze on repayment of capital will last until December 31, by which time the government hopes to have negotiated the extension of credit lines sufficient to cover the $12 billion in short-term portion.

Du Plessis also said the emergency exchange controls would discourage disinvestment because investors would not be able to export the proceeds from selling their holdings in South Africa. Payments of interest and dividends, and all trade, will be conducted at the commercial rand rate. However, the repatriation by foreign investors of their capital and profits thereon will be at the financial rand exchange rate.

Uncertain over the precise mechanism by which South Africa will repay any new debts, some leading US banks have ceased issuing the letters of credit for South African purchases of US goods. Because South African imports annually amount to about $14 billion and exports $18 billion, letters of credit are critical to the nation's economy. Such an interruption in short-term credit, following so closely after the international banking community's withdrawal of key short-term credit lines, will severely disrupt the South African economy.

South Africa is expected to say that it will spread repayments over a two-year period after the moratorium. Therefore, any new letters of credit treated in such a way would become quite expensive for the issuing bank. Without a guarantee from the governor of the South African central bank, no leading US bank is going to issue any more such letters of credit.

The rand declined again on September 3, to $0.42, perhaps indicating that neither the emergency financial measures nor the emergency visit to Western financial centers by the governor of South Africa's central bank, Gerhard de Kock, had been enough to restore confidence in South Africa's economy. It is apparent that confidence will not be restored without the cessation of violence and civil upheaval.

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RECENT DEVELOPMENTS

JAPAN

Two additional nuclear units recently began commercial operation in Japan. Tokyo Electric Power Company's Fukushima Unit II-3 (an 1,100-MWe BWR) and Kansai Electric Power Company's Takahama Unit 4 (an 870-MWe PWR) together increase the total number of commercial nuclear power plants in Japan to 30, having a combined total capacity of 22,531 MWe. The addition of Takahama Unit 4 to Kansai EPC's electricity grid increased the utility's nuclear generation to nine plants with a capacity of 7,408 MWe, the largest operational capacity in Japan at the time. Sixteen days later, Tokyo EPC's latest addition increased its operational nuclear plant capacity total to 7,996 MWe. In addition, the Fukushima unit established, for the plant's size and type, a new Japanese construction record of 55 months from start of construction to commercial operation. The expected addition of the 1,100-MWe Kashiwazaki Unit 1 BWR in October 1985 will further enhance Tokyo EPC's nuclear capability. The unit achieved criticality in December 1984 and is currently undergoing final testing.

In addition, the Power Reactor and Nuclear Fuel Development Corporation (PNC) announced that in October 1985 it will start construction of its 280-MWe demonstration fast breeder reactor, Monju. The often-delayed project, initially scheduled for 1985 operation, is now expected to be completed in the early 1990s.

Further information was announced recently regarding plans to construct enrichment and reprocessing facilities at a combined site at Rokkasho-Mura in the northern part of Japan's main island of Honshu (see Report 203). The reprocessing facility, scheduled for operation in 1995, will have an 800 tonne-per-day capacity. Japan Nuclear Fuel Services (JNFS), the utility-sponsored entity which will own the reprocessing facility, will contract to Mitsubishi Heavy Industries (MHI) as the lead company for design and construction. MHI will subcontract to a group of participating companies, including Toshiba, Hitachi, Mitsubishi Metals, and Sumitomo Metal and Mining. The Société Generale pour les Techniques Nouvelles (SGN) of France has been providing technical support for the project planning, and is expected to continue to do so as contractual arrangements are finalized by the end of 1985.

Japan Nuclear Fuel Industries (JNFI), another utility-sponsored company which will build and operate an enrichment facility at the same location, has finalized plans for the transfer of enrichment technology from PNC, which developed the technology as part of a government-funded program. This event will provide the basis for subsequent transfer of government-sponsored technology to the private sector. However, commercial considerations that may be involved in the arrangement have not yet been disclosed. Current plans for the enrichment facility call for a two-stage implementation: a 150,000 SWU-per-year capacity by year 1991 and a 1.5 million SWU-per-year capacity by year 2000 (or one-sixth of anticipated Japanese requirements).

In a related development, Uranium Enrichment Machinery Company (UEM) announced that in October 1985 it will begin construction of a factory for fabricating centrifuges for use in the JNFI enrichment facility. The UEM facility, located near Sendai City in northern Honshu, is scheduled for September 1986 completion. UEM is a joint venture company owned by Hitachi, Toshiba, and MHI, as well as various private companies which supported hardware development for PNC's enrichment technology.

* * *

Japanese research and development of a laser enrichment process has accelerated following the US DOE's decision to concentrate on the AVLIS method for future enrichment technology. In early August, Riken, a Japanese company, announced that its initial molecular laser enrichment experiments were successful. An infrared laser was applied to gaseous uranium hexafluoride (a molecular, rather than atomic, configuration) to separate fissionable U_{235} isotopes. Although the separation efficiency was low, experimenters view it as a successful step in the development of laser separation.

Experiments were conducted by cooling UF_6 gas to 35° C. below zero and exposing it to a high-efficiency, high-power hydrogen laser. Officials expect that the enrichment efficiency can be improved by cooling the gas to approximately 200° C. below zero.

Japan Atomic Energy Research Institute (JAERI) also is studying the atomic separation process, which uses atomic uranium metal instead of UF_6. It is likely, however, that research and development of the molecular method will be accelerated because of the advantages of using UF_6 gas, which is already used in centrifugal separation processes.

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PRIMARY MARKET CONVERTERS—COMURHEX

Introduction

The French company Comurhex operates uranium conversion facilities capable of producing approximately 12,500 MTU as UF_6 per year, ranking it second in nameplate capacity among the five free world converters (Table 1). Its facilities are located at two plant sites in France, one designed to produce uranium tetrafluoride (UF_4) and uranium metal (U), located near Narbonne on the Mediterranean coast, and one designed to produce fluorine (F_2) and uranium hexafluoride (UF_6), located at the Pierrelatte nuclear fuel cycle complex on the Rhone River south of Lyon (Figure 1 and Figure 2, top). Comurhex is the only one of the five commercial converters that has not yet sold conversion services directly to US utilities; its clientele has consisted primarily of European and Asian companies. Nevertheless, Comurhex currently is operating at approximately 70 percent of capacity, a rate equivalent to approximately 8,750 MTU per year. That production rate is probably the highest in the world right now as the North American converters have been particularly hard hit by the slump in the primary market for conversion services. Two reasons for this situation, in spite of the generally high level of UF_6 inventories held by market participants, are:

1. The relative stability of demand from Comurhex's traditional customers, most importantly Electricite de France (EDF) and Cogema;
2. The recent growth of the commercial enrichment business in Europe, which also corresponds with the declining overseas market share of the US DOE.

History and Ownership

Comurhex was incorporated in 1971 with the merger under a single management of the Malvesi UF_4 and U metal plant near Narbonne and the Pierrelatte fluorine and UF_6 plant. Previously the two plants had been owned by separate entities. The principal function of the Malvesi plant prior to 1971 had been to produce U metal for the French graphite-gas reactor (GCR) program, while the Pierrelatte facility produced UF_6 primarily for research and defense applications. Subsequently, the French government's decision in the early 1970s to pursue the commercial development of light-water reactors (LWRs), and the organization of the commercial enrichment consortium Eurodif, caused the focus of production at Malvesi to shift to UF_4 that could be fluorinated at Pierrelatte, yielding the UF_6 necessary for commercial uranium enrichment. Some historical UF_6 production figures, shown in Table 2, reflect the evolution of Comurhex's operations. The production of U metal has declined steadily since the peak of 1,000 MTU in 1976.

Ownership of Comurhex is held by Uranium Pechiney (51 percent), Cogema (39 percent), and Mokta (10 percent). Uranium Pechiney is a wholly owned subsidiary of the metals and chemicals company Pechiney, which was nationalized in 1983. Cogema is the state-owned fuel cycle company administered by the CEA (Commissariat a l'Energie Atomique), which has responsibility for both civilian and military nuclear fuel development. Mokta is a French mining company belonging to the Imetal group, of which Cogema is a leading shareholder. (See Report 187, March 1984, for an article on the French nuclear power structure.)

Table 1

FREE WORLD CONVERTERS

Company	Plant Location	Production Capacity (MTU as UF_6 per year)
Allied Corporation	Metropolis, Illinois	12,700
Comurhex	Pierrelatte, France	12,500
BNFL[1]	Springfield, UK	9,500
Sequoyah Fuels	Gore, Oklahoma	9,100
Eldorado Resources Ltd.	Port Hope, Ontario, Canada	9,000[2]

[1] British Nuclear Fuels Limited.

[2] An older conversion facility with a nameplate capacity of 4,500 MTU as UF_6 per year is not currently in service.

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FOCUS

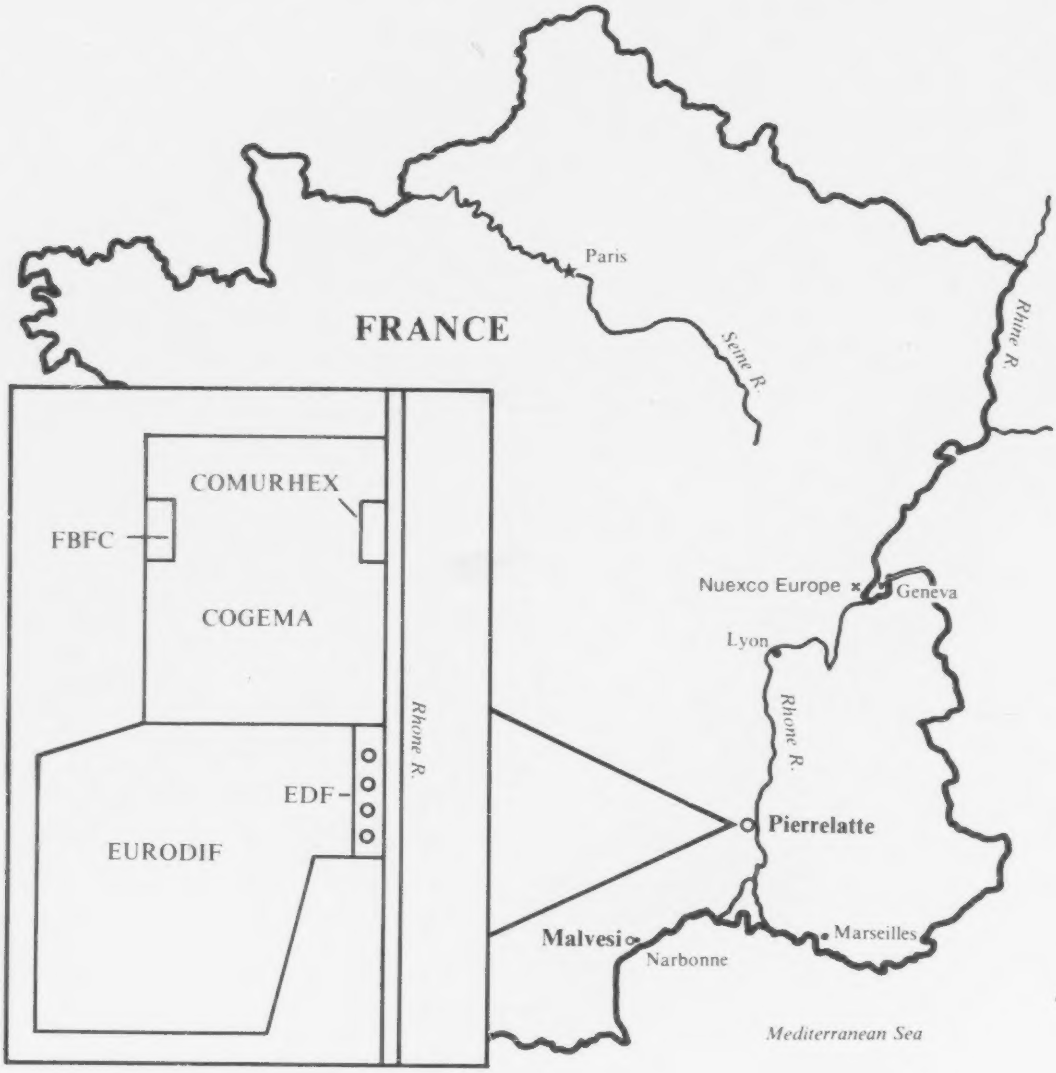
FRANCE
Paris
Seine R.
Rhine R.
COMURHEX
FBFC
COGEMA
EDF
EURODIF
Rhone R.
Nuexco Europe
Geneva
Lyon
Rhone R.
Pierrelatte
Malvesi
Narbonne
Marseilles
Mediterranean Sea

Figure 1. Location of Comurhex conversion plants. Concentrates are converted to UF_4 at Malvesi and trucked to Pierrelatte for conversion to UF_6. Inset illustrates the Pierrelatte nuclear fuel cycle complex, which includes EDF's four-unit Tricastin nuclear power plant (35 hectares), the Eurodif enrichment plant (250 hectares), the Comurhex plant (13 hectares), a FBFC (Societe Franco-Belge de Fabrication de Combustible) fabrication plant (12 hectares), and the Cogema research and national defense plant (200 hectares).

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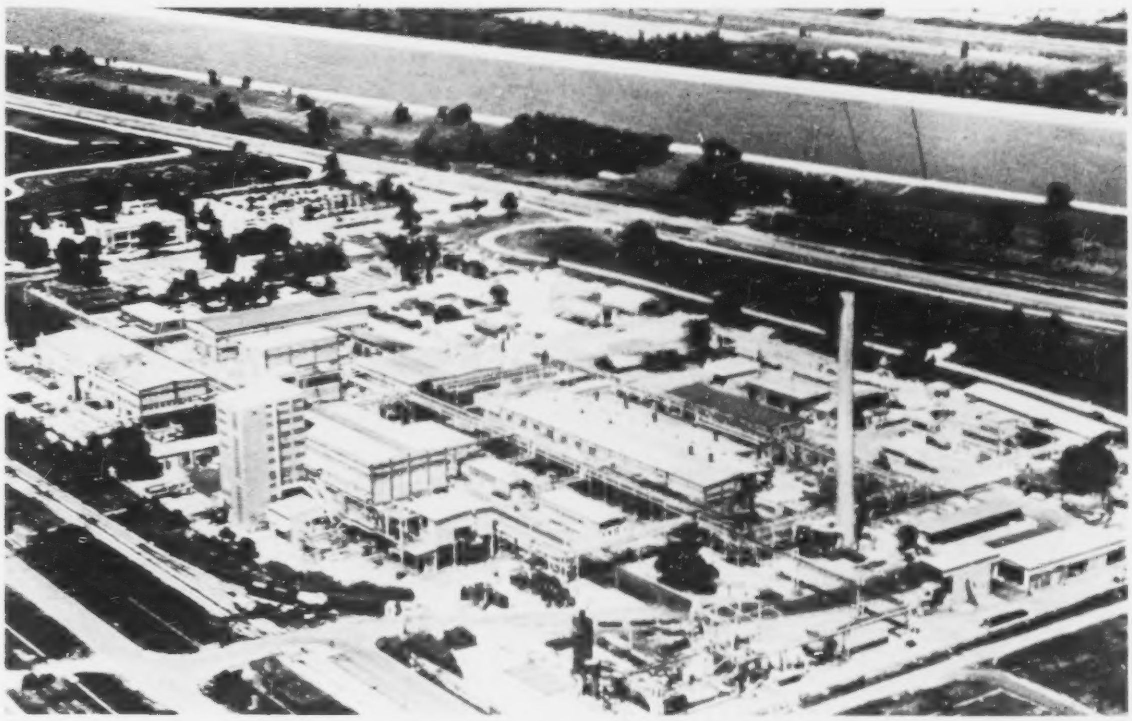

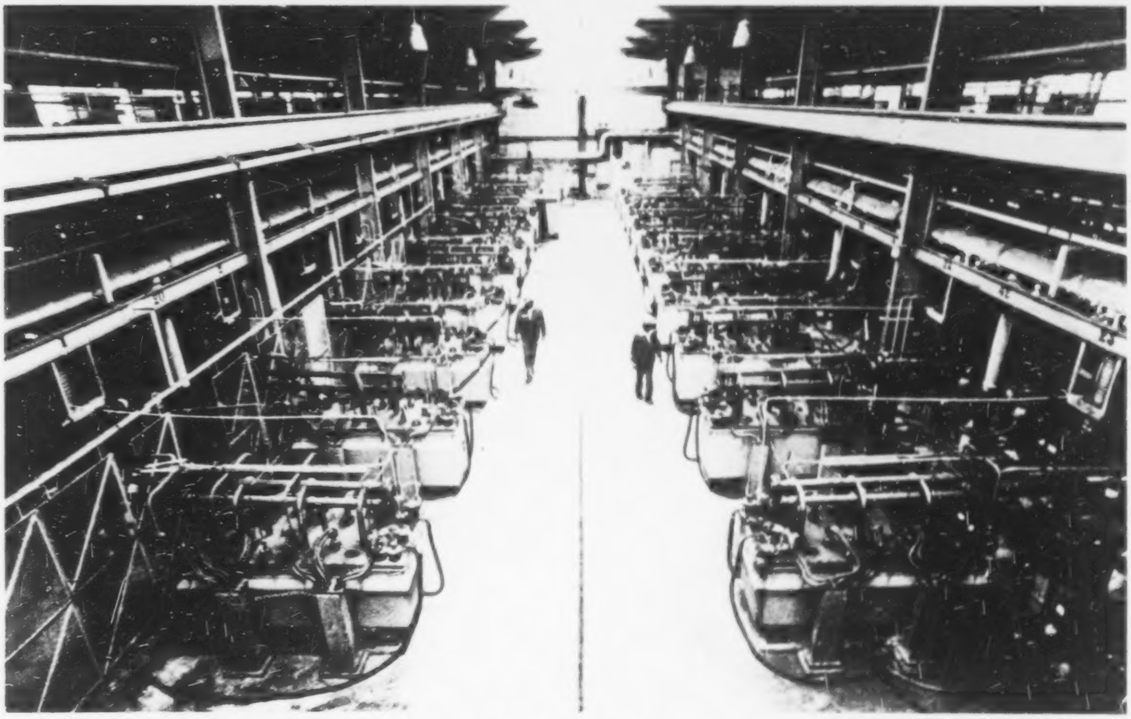

Figure 2. Above is an aerial view of the Pierrelatte UF_6 conversion plant. Below is the interior of the fluorine (F_2) production plant at Pierrelatte.

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Table 2
HISTORICAL UF_6 PRODUCTION AT COMURHEX

Year	MTU as UF_6
1973	1,700
1976	6,300
1980	10,900
1984	8,500

Delivery of Concentrates

Uranium from French mills arrives directly at the Malvesi plant by truck or rail, while concentrates from overseas sources normally arrive in France by ship at Marseilles or Bordeaux. They are then transported by rail to the Malvesi plant, approximately 200 kilometers away. Upon arrival, the feed material is weighed and sampled by Comurhex technicians, employing the falling stream sampling method. Following the determination of weights and assays, samples are distributed to the parties involved, and one is kept for umpiring in case of a dispute. The bulk concentrates are stored in the open yard until needed. Most customers keep their material as concentrates until UF_6 is required to fill enrichment orders, because concentrates are easier, safer, and cheaper to store than UF_6. The storage lot at the Malvesi plant site contains approximately 30,000,000 pounds U_3O_8.

Conversion to UF_6

Comurhex employs a wet conversion process, as do most of the commercial converters. The wet process begins with the dissolution of concentrates in nitric acid (Figure 3). The nitric acid solution flows through a counter-current exchange filter to yield a concentrated, impure solution of uranyl nitrate. Within a large purification column the uranyl nitrate solution is agitated with a solution of 40 percent tributylphosphate (TBP) and 60 percent dodecane ($C_{12}H_{26}$). Uranyl nitrate forms a complex with TBP, and is subsequently extracted from the complex in a separate purification column, yielding a pure solution of uranyl nitrate. The addition of ammonia (NH_3) to the pure solution forms ammonium diuranate (ADU), which is dried at high temperature. The injection of NH_3 at a temperature near 700 degrees C. produces UO_2. After cooling, the UO_2 reacts with hydrofluoric acid (HF) to yield uranium tetrafluoride (UF_4), or green salt.

The bulk of the UF_4 produced at Malvesi is shipped in special tank trucks to Pierrelatte, approximately 250 kilometers north. There it is airlifted into storage bins adjacent to the fluorination plant. Within the plant are three fluorination columns containing flame reactors. Fluorine gas moving through pipes from the nearby F_2 plant is injected into the fluorination columns and reacted with UF_4 at temperatures near 1,500 degrees C., producing UF_6. The UF_6 is filtered, cooled, and filled into standard Type 48Y cylinders for storage. Comurhex's UF_6 storage lot can hold approximately 175 cylinders (1,500 MTU as UF_6), depending on shipping schedules. UF_6 destined for Eurodif is trucked to the enrichment plant lot a few hundred meters south of the Comurhex facility. Eurodif has a much larger UF_6 storage capacity.

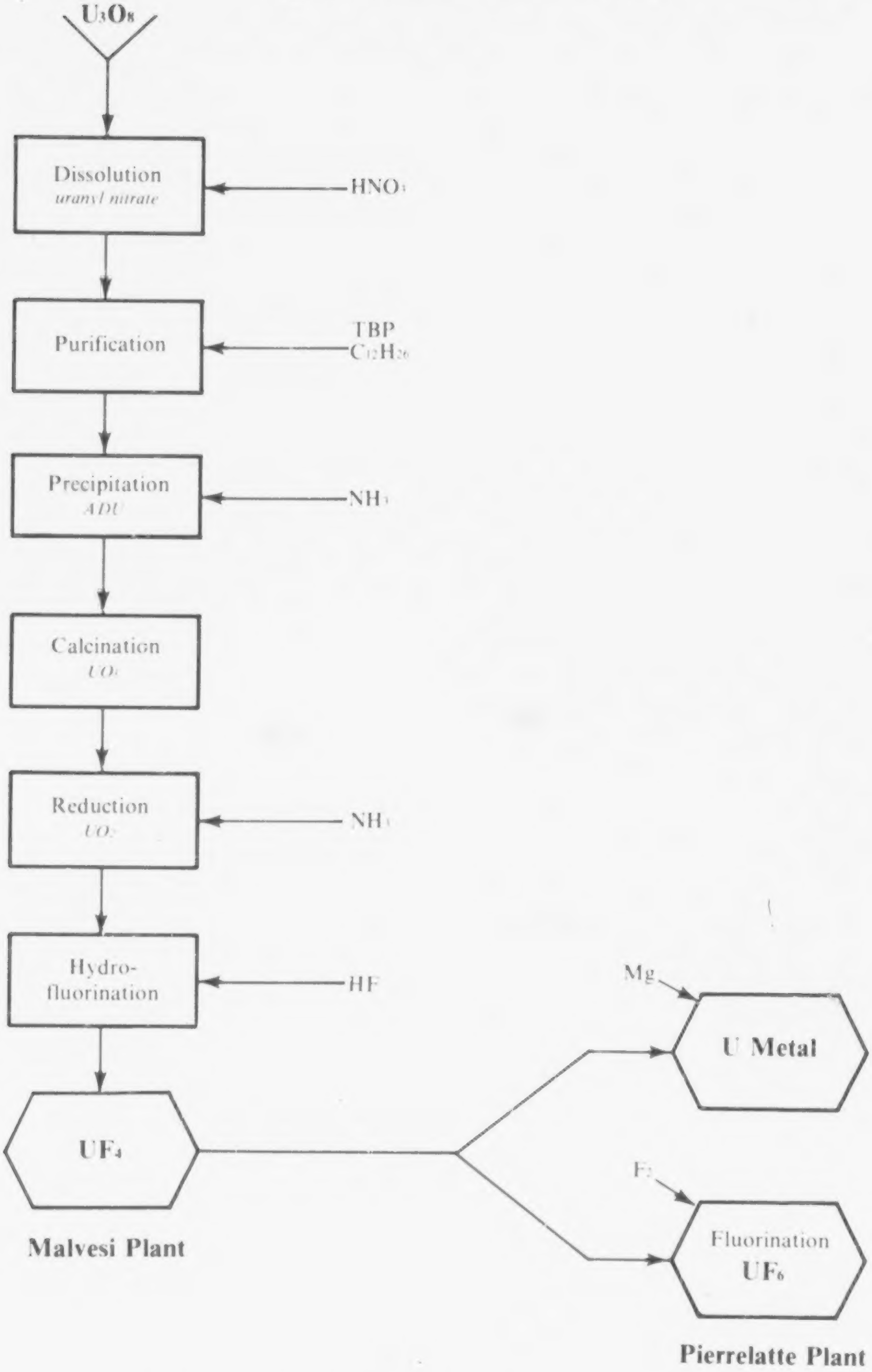
Comurhex operates the only commercial fluorine (F_2) plant in continental Europe at Pierrelatte (Figure 2, bottom). It sold its technology for F_2 production, the electrolysis of hydrofluoric acid (HF), to Eldorado of Canada. Also at Pierrelatte, Comurhex operates the only commercial facility which can reconvert to UF_6 uranium from reprocessing, or low enriched uranium of up to 2.5 weight-percent U_{235} in various forms. The reconversion facility currently has the capacity to process approximately 300 MTU per year. Comurhex is prepared to build commercial-scale facilities for this purpose if it becomes economical to do so. The company's management is currently evaluating a project plan, called Urex 2000, that would entail the construction of a modular plant able to convert 1,200 MTU per year of reprocessed material by the end of the decade.

Marketing

Comurhex has benefited from the ongoing expansion of the French nuclear power program, which is currently about half the size of the US program. It has thus far supplied most of EDF's conversion requirements. Nevertheless, in recent years foreign orders have accounted for more than 40 percent of its business (foreign sales accounted for more than 50 percent during the years 1977 to 1981). Secondary market inventory sales, inventory drawdowns, and cutbacks in nuclear power programs outside of France have affected Comurhex, if not quite as drastically as they have affected some other converters.

Comurhex has reported a recent surge in orders for the second half of the 1980s. The development of the European enrichment industry as competition for the US DOE is accelerating the recovery of the market for conversion services for Comurhex. For economic and/or political reasons, many European companies have chosen to avoid

Figure 3. Comurhex Conversion Process.


U_3O_8
Dissolution
uranyl nitrate
HNO_3
Purification
TBP
$C_{12}H_{26}$
Precipitation
ADU
NH_3
Calcination
UO_3
Reduction
UO_2
NH_3
Hydro-
fluorination
HF
UF_4
Malvesi Plant
Mg
U Metal
F_2
Fluorination
UF_6
Pierrelatte Plant

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American suppliers, at least for the intermediate term. Comurhex is currently offering a high degree of flexibility to its customers, many of whom suffered from rigid contracts in past years.

A number of long-term variables make it difficult to predict whether Comurhex will be able to sustain its market into the 1990s. The most important is the status of the Canadian upgrading requirement, which stipulates that U_3O_8 produced in Canada must be exported as UF_6 if possible. Canada is already the world's largest producer of U_3O_8, and all indications suggest that its position of leadership will continue to grow, particularly when the Cigar Lake deposit is developed. A number of European utilities are now purchasing Canadian uranium, and with each new purchase other converters potentially lose business to Eldorado Nuclear Ltd. Consequently, the future of the Canadian upgrading policy will have an effect on the European conversion business.

Comurhex's market could also change for other reasons. For example, a rupture in the European uranium trade with Southern Africa would present serious difficulties, as much of the concentrates currently run through the Malvesi plant are of South African or Namibian origin. The converter's share of the Japanese market is likely to diminish as the Japanese develop domestic conversion facilities. The Japanese government recently initiated a two-year study of the economics of a domestic plant.

CORRECTIONS AND AMPLIFICATIONS

The Raw Materials article on US uranium production in Report 204 contained several errors, both typographical and otherwise.

1. On page 19, under the heading "Projects Deferred," the first item should read "Conoco, one mine, Crownpoint, New Mexico," and the second item should read "Cotter, JD7 mine, Uravan District, Colorado."
2. On page 20, under the heading "Project Start-up" for 1982—Plateau Resources' 750 tpd mill at Ticaboo, Utah was also closed later that year.
3. On page 22, under the heading "Project Closures"—Quivira Mining's indefinite closure of all mining operations in McKinley, New Mexico should have been included.
4. On page 24, the first line should read "... but operating *mills* had increased to 26, the highest number to date."

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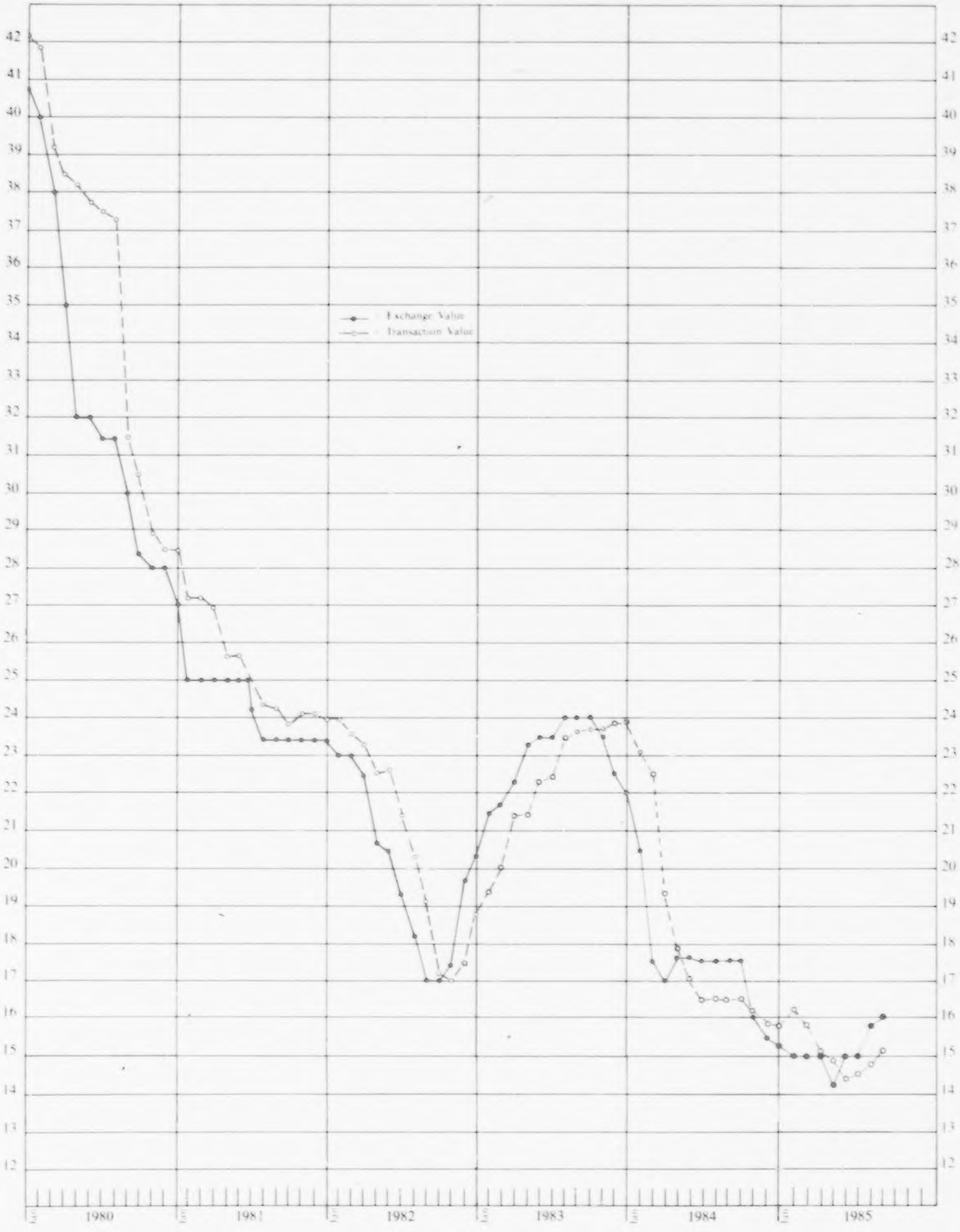
EXCHANGE AND TRANSACTION VALUES SINCE JANUARY 1980

Determined as of the last day of the month indicated



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HISTORICAL MARKET DATA

HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	—	—	—	—	—	—	—	6.35	6.35	6.40	6.45	6.50
1969	—	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	32.50	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00
1981	25.00	25.00	25.00	25.00	25.00	24.25	23.50	23.50	23.50	23.50	23.50	23.50
1982	23.00	23.00	22.50	20.75	20.50	19.25	18.25	17.00	17.00	17.50	19.75	20.25
1983	21.50	21.75	22.25	23.25	23.50	23.50	24.00	24.00	24.00	23.50	22.50	22.00
1984	20.50	17.50	17.00	17.75	17.75	17.50	17.50	17.50	17.50	16.00	15.50	15.25
1985	15.00	15.00	15.00	14.25	15.00	15.00	15.75	**16.00**				

HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	—	—	—	—	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38.40	37.90	37.60	37.30	31.60	30.60	29.00	28.70	27.70
1981	27.20	27.20	27.00	25.70	25.70	24.50	24.40	24.30	23.90	24.10	24.10	24.00
1982	24.00	23.70	23.40	22.60	22.70	21.50	20.30	19.10	17.30	17.00	17.55	18.80
1983	19.35	20.00	21.35	21.40	22.35	22.45	23.50	23.60	23.65	23.65	23.85	23.85
1984	23.05	22.50	19.25	17.90	17.00	16.50	16.60	16.40	16.55	16.05	15.90	15.90
1985	16.20	15.70	15.05	14.90	14.45	14.60	14.75	**15.10**				

HISTORICAL CONVERSION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U as UF_6)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	1.20	1.20	1.20	1.40	1.15	1.15	1.15	1.10	1.10	1.10	1.20	1.20
1982	1.20	1.20	1.20	1.20	1.00	1.00	1.00	0.90	1.10	1.60	1.45	1.45
1983	1.20	1.40	1.40	1.20	1.20	1.20	1.10	1.10	1.00	0.60	0.60	0.60
1984	0.60	0.30	0.80	0.80	0.80	0.00	0.00	0.80	1.00	1.00	0.80	0.80
1985	1.00	1.00	1.00	1.50	1.50	1.60	1.60	**1.60**				

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AUSTRALIA

	Price Index of Materials Used in Manufacturing Industry—All Groups[1] (1969=100)	Award Rates of Pay Indexes Australia—Adult Males In Mining Wage and Salary Earners, Weekly Rates[2] (1976=100)
1983 Avg.	401.2	181.8
May 1984	403.6R	197.0
Jun 1984	404.7	197.4
Jul 1984	408.3	197.4
Aug 1984	413.1	197.4
Sep 1984	411.9	197.4
Oct 1984	408.4	197.4
Nov 1984	407.1	197.4
Dec 1984	405.9	197.4
Jan 1985	409.3	197.4
Feb 1985	416.0	197.4
Mar 1985	429.4R	197.4
Apr 1985	440.2R	202.3
May 1985	451.8	202.3
Jun 1985	—	202.4

P = Preliminary R = Revised since last month

CANADA

	Industry Selling Price Index: Manufacturing[1] (1971=100)	Wage-earner Data: Average Hourly Earnings (C$)[2]					
		Uranium Mines (SIC 057)	Metal Mines* (SIC 051-059)	Mines, Quarries and Oil Wells[3] (SIC 051-099)	Primary Metal Industries Non-ferrous[4] (SIC 296)	Primary Metal Industries Non-ferrous[4] (SIC 298)	Chemicals and Chemical Products[5] (SIC 372-379)
1983 Avg.	298.8	—	—**	14.30	—	—	11.17
Aug 1984	312.7	17.24	15.36	14.92	12.44	10.34	11.78
Sep 1984	312.3	17.68	15.96	15.34	12.51	10.52	11.90
Oct 1984	312.3	17.64	16.15	15.26	12.69	10.56	11.96
Nov 1984	313.6	18.04	16.13	15.43	12.47	10.51	11.96
Dec 1984	314.2	17.95	16.39	15.60	12.16	10.40	11.99
Jan 1985	315.8	18.05	16.13	15.60	12.32	10.80	12.04
Feb 1985	316.5R	18.78	16.41	15.68	12.52R	11.05	12.06
Mar 1985	317.9	18.24	16.21	15.57	12.43	10.97	12.02
Apr 1985	318.2R	18.63	16.44	15.80	12.81	11.23	12.04
May 1985	318.8R	19.41R	16.51R	15.63R	12.76R	11.25R	12.15
Jun 1985	318.9	18.49P	16.20P	15.51P	12.89P	11.26P	12.12P
Jul 1985	319.5	—	—	—	—	—	—

P = Preliminary R = Revised since last month

For annual averages prior to 1983, and for notes pertaining to these statistics, see pages 23-26 of Report 190 of June 1984.

*The 1980 average for Metal Mines was incorrectly reported as 10.59. The correct average is 10.58 (see Report 190).

**Two different methods were used in the 1983 "Metal Mines" category in reporting survey data, and Statistics Canada did not publish a 1983 average. The March 1983 figure for the old method was 14.73 and for the new method was 14.84. The published average for 1983 in Report 190 was a Nuexco calculation based on the available monthly statistics for 1983 with the exception of the March figure, where only the 14.84 value was taken into account.

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GOVERNMENT STATISTICS

REPUBLIC OF SOUTH AFRICA

	Average Declared Working Costs per per Metric Ton of Gold Ore Milled (Rand)[1]	Tonnage-Weighted Index of Average Working Costs per Metric Ton of Gold Ore Milled (March 1982=100)[2]	Consumer Price Index[3] (1975=100)[4]	Producer Price Index All Groups[5] (1975=100)	Total Employment in Mining and Quarrying (Code 35)[6]	Total Salaries and Wages in Mining and Quarrying (1,000 Rand) (Code 40)[6]
1983 Avg.	51.87	115.0	262.2	274.8	696,579	3,644,772
Jun 1984	56.95	126.2	291.2	295.3	717,009	347,121
Jul 1984	—	—	295.1	296.0	717,121	369,964
Aug 1984	—	—	297.0	300.8	721,905	361,357
Sep 1984	60.64	133.2	299.9	304.1	721,470	359,218
Oct 1984	—	—	303.7	308.7	717,865	363,755
Nov 1984	—	—	307.4	312.8	717,396	369,771
Dec 1984	62.92	138.6	309.4	315.9	701,198	365,234
Jan 1985	—	—	177.1*	166.6*	711,366	376,777
Feb 1985	—	—	182.8*	171.3*	727,932	361,823
Mar 1985	64.48	142.4	183.6*	173.0*	708,809	371,380
Apr 1985	—	—	187.4*	174.0*	724,187	369,005
May 1985	—	—	189.5*	177.7*	708,085	373,478
Jun 1985	67.42	148.9	191.9*	179.2*	—	—
Jul 1985	—	—	193.6*	—	—	—

*The basis for calculation for these indices has been revised to January 1980 = 100.

UNITED STATES

	Producer Price Index[1]		Consumer Price Index[2]	GNP Implicit Price Deflator[3]	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[4]			
	Industrial Commodities (1967=100)	All Commodities (1967=100)	(1967=100)	(1972=100)	Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)	Electric and Electronic Equipment (SIC 36)
1983 Avg.	315.8	303.1	298.4	215.63	12.57	13.43	10.59	8.65
May 1984	323.3	311.7	309.7	—	12.99	13.37	11.02	8.89
Jun 1984	323.9	311.4	310.7	222.40	12.96	13.40	11.03	8.91
Jul 1984	324.0	312.0	311.7	—	13.02	13.36	11.12	8.95
Aug 1984	323.5	310.9	313.0	—	13.10	13.51	11.13	9.00
Sep 1984	322.3	309.5	314.5	224.57	13.20	13.39	11.23	9.08
Oct 1984	323.2	309.4	315.3	—	13.23	13.53	11.32	9.09
Nov 1984	323.8	310.4	315.3	—	13.23	13.76	11.35	9.15
Dec 1984	323.0	309.9	315.5	226.10	13.28	13.66	11.37	9.27
Jan 1985	322.9	309.5	316.1	—	13.29	13.70	11.39	9.33
Feb 1985	322.5	309.2	317.4	—	13.30	13.73	11.39	9.33
Mar 1985	322.6	308.7	318.8	229.07	13.29	13.95	11.37	9.39
Apr 1985	323.8	309.3	320.1	—	13.43	13.62	11.48	9.40
May 1985	325.3	309.9	321.3	—	13.24	13.59R	11.46	9.39R
Jun 1985	324.7R	309.1R	322.3	230.62R	13.27P	13.69P	11.51	9.47
Jul 1985	324.3	309.0	322.8	—	—	—	11.61P	9.51P

P = Preliminary R = Revised since last month

For annual averages prior to 1983, and for notes pertaining to these statistics, see pages 23-26 of Report 190 of June 1984.

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NUEXCO

EXECUTIVE SUMMARY
REPORT 205
(All data as of August 31, 1985)

Exchange Value
$16.00, up $0.25

The **Exchange Value** is **$16.00** per pound U_3O_8, up $0.25 since last month.

UF_6 Value
$44.50, up $0.50

The **UF_6 Value** is **$44.50** per kilogram U as UF_6, up $0.50 since last month.

Transactions

Three recent natural uranium sales are reported, involving approximately 400 thousand pounds U_3O_8 equivalent. All three sales involved spot or near-term delivery and met the conditions for inclusion in the Transaction Value. One of the sales involved natural UF_6.

Supply-Demand Ratio
fell to 2.8:1

Active spot and near-term **uranium supply** amounts to **3.3 million** pounds U_3O_8 equivalent, up 305 thousand pounds since last month. Active spot and near-term **uranium demand** totals **1.2 million** pounds, up 750 thousand pounds. The spot and near-term **supply-demand ratio** fell to **2.8:1.**

Transaction Value
rose to $15.10

The **Transaction Value** is **$15.10** per pound U_3O_8, up $0.35 since last month. The calculation includes 14 transactions involving a total of 2.4 million pounds U_3O_8 and equivalent UF_6, and covers a period of 3 months.

Loan Use Charge Rate
unchanged at 5%

The **Loan Use Charge Rate** is **5 percent** per annum, unchanged.

Conversion Value
unchanged at $1.60

The **Conversion Value** is **$1.60** per pound U as UF_6, unchanged since last month. Active secondary market supply for conversion services for delivery within three years totals 325 thousand pounds U as UF_6. Active demand totals 525 thousand pounds U as UF_6.

SWU Values unchanged:
$85 for DOE-origin
for delivery by
the end of FY86
$81 for non-DOE origin
for delivery by the end
of calendar year 1986

The **SWU Value** for DOE origin at .3 tails and certifiable as excess, is **$85** per SWU for delivery by the end of FY86. The SWU Value for other SWUs (non-DOE or non-certifiable) is **$81** per SWU for delivery by the end of calendar year 1986. One secondary market SWU transaction is reported, involving less than 50 thousand SWUs.

South Africa

Continuing social unrest and increasing international pressure have combined to deal severe blows to South Africa's economy. The possibility of international sanctions, the mineworkers' strike, and declining currency values have deepened the sense of crisis, yet the large uranium stockpiles held by producers should keep supply channels open for the foreseeable future.

Japan

Two more nuclear units entered service, bringing the total number of operating reactors to 30, having a combined capacity of 22,500 MWe. Also, officials recently announced new developments in laser enrichment research.

Focus

Comurhex provides uranium conversion services for the commercial market, and ranks second among the five free world converters in nameplate capacity. However, despite a large worldwide oversupply of conversion services, Comurhex is able to maintain a relatively high market share by virtue of its concentration on the European and Asian markets.

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NUEXCO

NUEXCO REPORT 205 FIGURES OF THE MONTH (August 31, 1985)	This Month (Report 205)	Last Month (Report 204)	12 Months Ago (Report 193)
Exchange Value[1]	16.00	15.75	17.50
Transaction Value[1]	15.10	14.75	16.40
UF_6 Value[2]	44.50	44.00	—
Loan Use Charge Rate[3]	5%	5%	6%
Conversion Value[4]	1.60	1.60	0.80
Near-Term Uranium Supply[5]	3.3	3.0	5.1
Near-Term Uranium Demand[6]	1.2	0.5	1.1
Near-Term Supply-Demand Ratio	2.8	6.7	4.6
Recent Uranium Sales:			
Number of Transactions[7]	3	8	4
Quantity of Material[8]	0.4	1.8	1.0
Nuexco SWU Values:[9]			
DOE origin, certifiable as excess, 0.3 tails assay; delivery before the end of FY86	85	85	—
Other SWUs (non-DOE or non-certifiable) delivery by the end of calendar year 1986	81	81	—
USDOE SWU Prices:			
USEC	135.00	135.00	135.00
AFC	153.00[10]	153.00[10]	153.00[10]
Requirements	157.00[10]	157.00[10]	157.00[10]
Market Value of Enriched UF_6[11] [12]:			
2.5 w/o U_{235}	459	455	537
3.0 w/o U_{235}	589	585	691
3.5 w/o U_{235}	722	717	848
4.0 w/o U_{235}	857	851	1,008

---

[1] US $ per pound U_3O_8 equivalent.

[2] US $ per kilogram U as UF_6.

[3] Per annum.

[4] US $ per pound U as UF_6.

[5] Active inquiries to sell, for delivery within 12 months after contract signing (millions of pounds U_3O_8).

[6] Active inquiries to purchase, for delivery within 12 months after contract signing (millions of pounds U_3O_8).

[7] Uranium sales only; does not include loans, conversion, or SWU transactions.

[8] Millions of pounds U_3O_8, equivalent.

[9] US $ per SWU.

[10] Effective 10/1/84.

[11] Calculated using the Nuexco Exchange Value, Conversion Value, and 0.30 percent tails assay. From 3/30/84 through 4/29/85, calculations used the Nuexco SWU Value for DOE origin and FY85 delivery. As of 4/30/85, calculations use the Nuexco SWU Value for DOE origin and delivery by the end of FY86.

[12] US $ per KgU as UF_6, rounded to the nearest $.

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MONTHLY REPORT

ON THE NUCLEAR FUEL MARKET

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MONTHLY REPORT ON THE NUCLEAR FUEL MARKET
October 1985 No. 206

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To Our Readers

Nuexco will host a hospitality suite during the Atomic Industrial Forum's Annual Conference in San Francisco, California. The suite will be located at the Westin St. Francis Hotel, November 10-13. We look forward to seeing you there.

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NATURAL URANIUM AND SECONDARY MARKET CONVERSION

(All data as of September 30, 1985)

The **Exchange Value** is **$16.00** per pound U_3O_8, unchanged since last month. **Active supply** of natural uranium (U_3O_8 and UF_6) for spot or near-term delivery totals **2,095,000** pounds equivalent U_3O_8 as concentrates or UF_6, down 1,245,000 pounds since last month. The corresponding figure for **active demand** is **1,100,000** pounds, down 105,000 pounds. The spot and near-term **supply-demand ratio** fell to **1.9:1.**

The *Current Market Data* section of this Report lists four natural uranium sales transactions, involving a total of approximately 300,000 pounds U_3O_8 equivalent. All of the transactions reported this month involved deliveries in the near term, and three met the criteria for inclusion in the current Transaction Value calculation.

The **Transaction Value** is **$15.10** per pound U_3O_8, unchanged since last month. Transactions reported this month, all of which took place at prices less than the current Exchange Value, only added approximately 300,000 pounds to the calculation. Because that accounts for only about ten percent of the total material in the calculation, the new sales had only a negligible effect on the Transaction Value. The current Transaction Value includes 17 transactions involving a total of 2.7 million pounds U_3O_8 or equivalent UF_6, and covers a period of 4 months.

The **UF_6 Value** is **$44.50** per kilogram U in UF_6, unchanged since last month. Two of the transactions reported this month involved UF_6.

The **Conversion Value** is **$1.60** per pound U in UF_6, unchanged since last month. One conversion transaction, involving 100,000 to 300,000 pounds U as UF_6, is reported. No active demand for conversion is reported. Active supply of secondary market conversion services for delivery within three years totals 100,000 pounds U as UF_6; only a few conversion sellers are currently indicating an interest in the near-term market. The conversion value this month again exceeds the algebraic equivalent determined by the difference between the UF_6 Value and the Exchange Value. The UF_6 market continues to be led by UF_6 inventory sellers motivated by immediate sales, while the thin conversion market is characterized by highly discretionary supply for inconsistent demand.

The **Loan Use Charge Rate** is unchanged at **5 percent** per annum, as both lenders and borrowers continue to express their interest in doing business at that level.

* * *

The Exchange Value held steady at $16.00, and the UF_6 Value remained at $44.50 per kgU as UF_6, as market activity during the last week of the month reflected prices around those levels. Despite a general belief that prices are on the verge of upward movement, little new demand for spot or near-term material appeared in the market during September, so the anticipated movement had not materialized as of the last day of the month. *Active sellers* continue to offer their material at prices up to two percent above the current values, but recent transaction prices have been below the current Exchange Value and UF_6 Value. Buyers are generally interested in bargain prices below the current values, but, as has been the case for the past several months, some sellers continue to offer their material at prices well above competitive levels.

The UF_6 Value remains slightly less than the algebraic sum of the Exchange and Conversion Values. One seller, in order to liquidate one lot of UF_6 on short notice, discounted it substantially below the current UF_6 Value in order to conclude the sale. One buyer that had made an open request for offers concluded a purchase in the last week of the month at a price near the current Exchange Value.

The US dollar continued its decline against most currencies, reaching a four-year low against the Japanese yen. The decline again served to discourage sellers of spot or near-term material, while helping buyers intent on purchasing at dollar prices. One European buyer, in a deal arranged during the previous month, paid an effective price on delivery that was well below the price established at the time of contract signing, due to the subsequent strengthening of the buyer's currency relative to the dollar.

Two recent developments in the USA have already begun to induce a period of market uncertainty likely to persist for months; they were:

1. A federal court ruling that the USEC is invalid.
2. The declaration by the Secretary of Energy that the US uranium production sector is not viable.

Occurring almost simultaneously near the end of the month, the above events have fueled speculation of three kinds:

1. That various forms of relief will be granted to US producers;
2. That the invalidation of the USEC will free DOE customers, particularly overseas, to sign replacement contracts with Urenco and Eurodif;

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3. That a two-tiered market will arise, in which US-origin uranium will command a premium of $5 to $10 per pound U_3O_8.

The US producers' suit against DOE has yet to be resolved. Although the judge ruled in favor of the producers that the USEC contract is not valid, DOE has filed notice that it intends to appeal; furthermore, four more issues in the five-count dispute remain to be judged. The entire issue is ruled by political realities, so its outcome will be determined largely by non-economic factors.

While there still exists a general sentiment in the market that prices will rise soon, a pervasive uncertainty growing out of recent external events is becoming more influential in the behavior of market participants. The fact that most utilities still have substantial inventories is tempering sellers' optimism. Non-US sellers must continue to evaluate the pace of the dollar's movement relative to the change in market prices; some non-US sellers may choose to sell now rather than accept the currency risk. However, the size of the US federal deficit continues to qualify any currency speculation.

The increased probability that certain utilities will be forbidden to use South African uranium in power plants is forcing utilities and other entities holding South African-origin uranium to decide whether to sell that material or to continue holding it in inventory.

The development of the near-term market will be influenced by these factors and others. However, neither the extent, nor the direction, nor the timing of price movement is clear.

ENRICHED URANIUM AND SWUS

The Nuexco **SWU Values** as of September 30, 1985 are:

1. For **DOE origin,** a tails assay of 0.30 weight-percent U_{235}, for delivery by the end of FY86, and certifiable as excess, $85 per SWU, unchanged.

2. For **other** SWUs (includes DOE origin SWUs not certifiable as excess and non-DOE origin SWUs), for delivery by the end of calendar year 1986, $78 per SWU, down $3.

The SWU Value for DOE certifiable SWUs was unchanged and the value for SWUs of non-DOE or non-certifiable origin fell slightly, although the distinction between the two categories became blurred by the end of September. The September 19 ruling by a US District Court Judge in Denver that the USEC is null and void could, if it is upheld, nullify the market for certifiable SWUs, as that market is a creation of the USEC. However, as of the last day of the month, it was Nuexco's judgment that the implications of the court decision on the USEC were not yet clear enough to warrant a change in the interpretation of the pricing structure of the secondary market. (See separate article, this Report, page 4.)

Three secondary market SWU sales are reported this month, involving 50 to 100 thousand SWUs of both DOE and Eurodif origin. The demand for DOE-certifiable SWUs continues to be thin and sporadic in view of the heavy supply, and competition for significant quantities of SWU has been heated. Without the presence of a firm buyer, however, sellers had little opportunity to compete with one another, so there was little downward pressure on prices. Most transactions in the past few months have involved relatively small quantities. The non-DOE market has been relatively inactive in recent months, and that fact has made it difficult to assess changes in the SWU value. Steadily declining offers for substantial quantities of non-DOE SWU caused the value to be lowered slightly. However, if the USEC is in fact invalidated, the non-DOE market could revive rapidly in the coming weeks, and higher prices could be expected.

* * *

SWU PRICE FOR HIGH-ENRICED URANIUM

Nuexco's interpretation of the conditions of DOE's new "high assay charge" caused an incorrect analysis of the weighted average price for 93-percent enriched uranium in the *Pricing* section of Report 205 (September 1985, page 2). While DOE has not formally issued procedures for determining the average SWU price, the following equations provide a better representation of the cost structure, and are expected to be the basis for the official price determination.

The total SWU per kgU of enriched product is given by

$$S/P = V_p - V_w - F/P\,(V_f - V_w)$$

where V is the value function

$$V_x = (2x - 1)\,\mathrm{Ln}\,(x/[1 - x])$$

and

$$F/P = \text{Total kgU feed per kgU of enriched product} = (X_p - X_w)/(X_f - X_w)$$

X_p = product enrichment (weight-fraction U_{235})
X_f = feed enrichment
X_w = waste (tails) enrichment

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The Separative work per kilogram of product required to be performed above a given cutoff enrichment level "s" is given by

$$S/P_s = V_p - V_s - (x_p - x_s)(dV/dx)_s,$$

where $(dV/dx)_s$ is the derivative of the V function with respect to x, evaluated at s:

$$(dV/dx)_s = (2x_s - 1)/(x_s[1 - x_s]) + 2\,\mathrm{Ln}\,(x_s/[1 - x_s]).$$

The SWU price for high enriched uranium is the w[illegible] average of the low enriched SWU price (currently [illegible]) and the price of the SWU needed at above 10 percent ($492 after April 1, 1986):

$$\text{SWU price} = \frac{\$492\,(S/P_s) + \$125\,(S/P - S/P_s)}{S/P}.$$

As an example for 93-percent enrichment:

$S/P = 235.550$
$S/P_s = 11.492$

$$\text{SWU price} = \frac{\$492\,(11.492) + \$125\,(224.058)}{235.550} = \$142.80.$$

Nuexco's original price estimates assumed that the "high assay charge" would apply to the total number of SWUs required to enrich product from the cutoff point (10 percent) to the product assay. However, this total includes SWU performed at less than the cutoff enrichment level in order to "strip the tails," that is, reduce the enrichment of the waste stream down to the tails assay level. The DOE prices (and costs) are only increased for separative work performed above the cutoff enrichment level, so Nuexco's original price estimate of $184 per SWU for 93 percent incorporated too many SWU at the $492 price, and thus was too high. The enrichment cascade and the material flows are illustrated schematically in Figure 1.

DOE customers with USEC contracts have a contract ceiling price for SWU which is currently about $134. DOE is expected to charge these customers the ceiling price for the SWU needed above 10-percent enrichment, so the average SWU cost for USEC customers will be only about $125.44 for 93-percent enriched product.

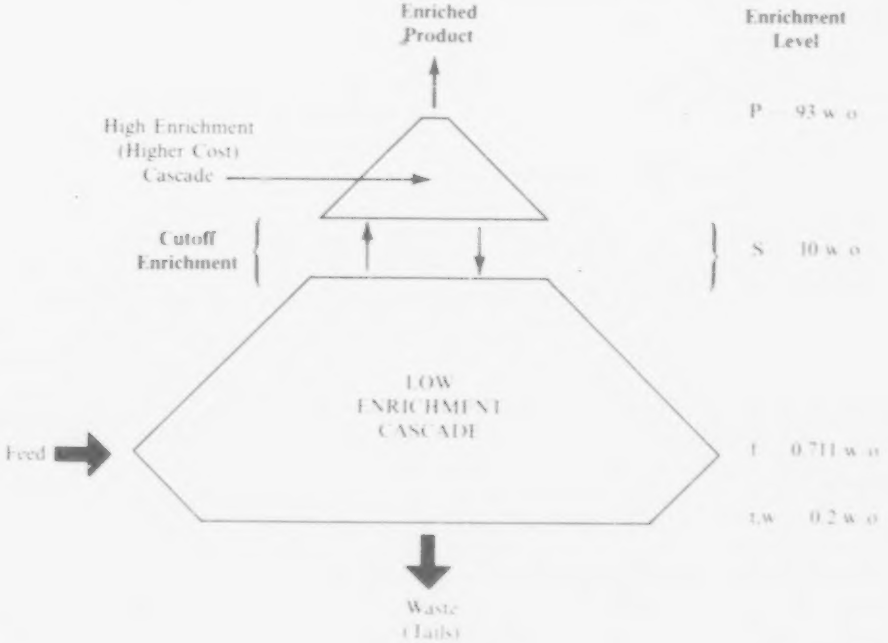

Figure 1

CASCADE DIAGRAM
FOR HIGH-ENRICHED PRODUCT

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PRICING

Two September events in the USA could have profound effects on the entire front-end of the nuclear fuel cycle worldwide.

1. The US District Court in Denver, Colorado ruled that DOE's Utility Services enrichment contract (USEC) "amounts to a change in criteria under which enrichment services are to be performed." Because the contract was not submitted to Congress for review as required by law, Judge Carrigan declared the USEC null and void.

2. One week later US Secretary of Energy Herrington declared that the US uranium production industry was no longer viable.

INVALIDATION OF THE USEC

Judge Carrigan's ruling, first announced September 16 and amended September 19, addressed Count II of a five-count civil suit filed against DOE in December by three US uranium producers – Western Nuclear, Inc.; Energy Fuels Nuclear, Inc.; and Uranium Resources, Inc. The action had the support of other US producers, who later joined in the formation of an industry trade group called the Uranium Producers of America (UPA). That body has since assumed the leadership of the group's legal efforts. In Count II, the suit sought a declaration that the USEC is null and void and an order prohibiting DOE from adopting a generic enrichment contract without compliance with the Administrative Procedures Act. Report 197 of January 1985, on page 20, contains additional background information on the events leading up to the filing of the suit.

Under the Atomic Energy Act, DOE is required to establish written criteria describing terms and conditions for enrichment services. Furthermore, the adoption of any new criteria requires submission of the contract to Congress for review. In his order, Judge Carrigan stated that the critical issue regarding the USEC was that it "... [amounted] to new criteria governing enrichment." He cited three examples:

1. Existing criteria governing enrichment require that the primary DOE enrichment contract must be of a Fixed Commitment type, which the USEC clearly is not.

2. The USEC sets a ceiling price for enrichment services, which conceivably could prevent the government from recovering its costs. In 1973, for the same reasons, a similar provision which guaranteed a ceiling price was deleted from original criteria established in 1966.

3. Provisions in the USEC that base termination penalties on the period of notice that the customer gives DOE, rather than on recovery costs derived from DOE estimates of customer terminations, should be considered new criteria.

Thus, Judge Carrigan declared the contract null and void, and entered a summary judgment in favor of the producer group and against DOE with respect to Count II of the suit. DOE soon afterward filed a notice of its intent to appeal the ruling, a measure which extended to 60 days the period allowed for filing an appeal.

The four still-pending counts of the suit sought a wide range of relief.

Count I: requested a reimposition of the US embargo on foreign uranium. It asserted that, under the Atomic Energy Act [§161(v), 42 U.S.C. §2201(v), enacted in 1964], DOE is obligated to limit the enrichment of foreign uranium for domestic end uses so as to "assure the maintenance of a viable domestic uranium industry." The plaintiffs asked the court to take three actions under this count:

a. To declare the meaning of the term "viable" as employed in §161(v);

b. To order DOE to begin proceedings leading to the adoption of limits on enrichment of foreign-source uranium for domestic end use;

c. To order DOE to impose interim limitations on such enrichment, pending the outcome of such proceedings.

Some producers believe Herrington's declaration that the US industry is not viable will expedite a judgment on this count.

Count III: Because the surcharge for the variable tails assay option (VTAO) under the USEC tends to reduce uranium consumption, the suit sought to require DOE to allow customers to vary their tails assays at no charge.

Count IV: sought to prohibit the use of the federal government stockpile, either through sales of pre-production inventories or through over-feeding the enrichment cascades (to save power costs). Although such uses of the stockpile do not reduce uranium consumption in reactors, it can be argued that any reduction of USDOE stockpiles also reduces market opportunity for US producers.

Count V: sought judicial validation and enforcement of the principle that the US industry shall be maintained in a condition such that it shall be capable of supplying 100 percent of US requirements at any time, and under any hypothetical scenario for supply disruption. It asserted that the criteria for assessing the viability of the US industry [48 *Fed. Reg.* 45746 (Oct. 6, 1983)] were issued by DOE unlawfully in that the final regulation differed from that published for review so markedly as to be entirely different. It also asserted that the criteria selected by DOE failed to meet the requirements for, among other reasons, requesting relief under Section 262 of the Trade Expan-

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sion Act of 1962 (19 U.S.C. §1862) and Section 201 of the Trade Act of 1974 (19 U.S.C. §2251). The plaintiffs' main complaint with the adopted viability criteria was that they allowed for the inclusion of stockpiles to satisfy requirements, while the plaintiffs would prefer that viability depend on the industry's ability to supply 100 percent of requirements, even in the event of certain import supply disruption scenarios.

Of all the possible scenarios, complete abandonment of the laboriously constructed USEC seems the least likely. At the very least, such an action would severely impair DOE's already strained credibility with its customers, particularly those from overseas. Urenco and Eurodif probably would add to their already substantial gains at DOE's expense. Further penetration of the US market would become a distinct possibility as well. Because the establishment of new criteria requires Congressional review, DOE may simply submit the contract for that review. Such a tactic would provide time for DOE to perform the necessary lobbying in Congressional circles to ensure that the legality of the USEC is upheld. Other possible DOE responses include the restructuring of various provisions in the contract that have received the most criticism. In the meantime, however, DOE would like to continue business as usual. Customers may preempt that strategy by taking actions of their own, such as non-payment or non-acceptance of enrichment obligations incurred under the USEC.

NON-VIABILITY OF US URANIUM INDUSTRY

As expected and in spite of conflicting pressures from the US State Department, Energy Secretary Herrington announced on September 26, 1985 that the US uranium industry is not viable. Declaring that "I have taken steps to help the miners and millers in this important industry that is currently under a great deal of strain.", he:

1. Authorized DOE to offer a free VTAO each year to all customers that commit to buy 100 percent of their requirements from DOE over a rolling five-year period. It would save about $9/SWU for customers that select 0.30 weight-percent tails. This item was sought under the still-pending Count III of the producers' suit against DOE; perhaps now it has been rendered moot by the invalidation of the USEC.

2. Postponed for one year a DOE plan to feed some of its own uranium stockpile into enrichment plants. This item was also sought in the producers' suit (Count IV).

3. Asked the United States Trade Representative to examine the facts and implications of uranium imports and corresponding foreign trade and policy issues with a view to determining the appropriate courses of action under US trade laws. The Trade Representative will report back in three months.

One of the reasons given for Herrington's declaration of non-viability was the US mining industry's reported loss of more than $200,000,000 for 1984. That amount is a decline of $240,000,000 from 1983, when the industry reported a net profit of almost $40,000,000 and then-Energy Secretary Hodel declared the industry viable. Those figures do not take into account the producers that have already been forced out of the business. That DOE was able to wait so long to recognize what has been evident for at least three years indicates that the entire issue of the industry's viability is determined much more by political factors than by economic ones.

The declaration of non-viability has had, as yet, no direct effect. Sections of the legislation that require the Secretary of Energy to review the industry's viability (an amendment to a budget authorization) discuss what the Secretary could do or should do, but do not direct his actions in the event that he determines non-viability. For example, one section says:

"The Secretary . . . may determine . . . that source material [natural U] or special nuclear material [enriched U] . . . is being imported in such increased quantities as to be a substantial cause of serious injury, or threat thereof, to the US uranium mining and milling industry." If Herrington had made such a determination, then the US Trade Representative would be required to request an investigation by the US International Trade Commission. However, he did *not* make such a determination; he only asked the US Trade Representative to look into the matter and advise Herrington. In other words, Herrington asked for one investigation to determine whether he should initiate another. The US Trade Representative is supposed to report to Herrington in 90 days, so a decision on this point is likely in early 1986. And again, that decision more likely will be political rather than economic.

Another section says:

"If . . . the Secretary . . . determines that contracts . . . for . . . material from foreign sources . . . represent greater than 37½ percent of actual or projected domestic uranium requirements for any two-consecutive-year period," [That same point is listed as one of the criteria for viability, but was *not* cited as the basis for Herrington's declaration of non-viability.] *or,* if the Secretary determines that im-

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ports represent a threat to national security, then "the Secretary . . . shall request the Secretary of Commerce to initiate" an investigation under the Trade Expansion Act of 1962. If the government, as represented by the Secretary of Commerce, then determined that a threat to national security existed, trade barriers could be erected. Again, such a determination would be based almost solely on political considerations.

Conclusions

1. Any further actions by DOE will depend on political considerations.

    a. Will the US Trade Representative recommend an investigation by the US International Trade Commission? Only if the Reagan Administration wants him to do so.

    b. Will Herrington rule that imports threaten national security? Not unless Reagan wants him to do so.

    c. In either case, there is simply too little political benefit and too much political risk. Workers (or ex-workers) in larger industries that have been denied similar relief, such as steel, automobile manufacturing, shoe manufacturing, and semiconductors, might very well retaliate at the polls.

2. As yet neither the uranium nor SWU markets have moved in response to these two events. Buyers and sellers alike appear to have adopted a wait-and-see attitude. There is a commonly held view that, despite the complexity engendered by multiple contending interests, a prompt resolution of the uncertainties created by these related events is essential.

3. Because the interests of the affected parties vary so widely, no resolution can please everyone. Some US producers, having chosen to leave the uranium business, are primarily interested in mill tailings legislation. Other US producers, having decided to stay in the uranium production business, place highest priority on a foreign uranium embargo. Most US utilities oppose an embargo. Some DOE customers would like nothing more than the opportunity to get out of their DOE commitments. Other utilities want only to see the matter settled. DOE has substantial markets and cash flow at risk and hopes to reverse the invalidation of the USEC. The Administration has difficult foreign relations and commercial considerations with which to contend. It seems likely that a final resolution will require each to give up something in order to gain something.

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CURRENT MARKET DATA

September 30, 1985	Market Values	Active Supply[1] (thousands)	Active Demand[1] (thousands)
EXCHANGE VALUE	**$16.00**/lb. U_3O_8	2,095	1,100
UF_6 VALUE	**$44.50**/kgU		
CONVERSION VALUE	**$1.60**/lb. U as UF_6	100	0
SWU VALUES			
DOE origin, certifiable as excess, 0.3 tails assay delivery by the end of FY86	**$85**/SWU		
Other SWUs (non-DOE or non-certifiable) delivery by the end of calendar year 1986	**$78**/SWU		
LOAN USE CHARGE RATE	5% annum	2,000	500

	$/lb. U_3O_8	Millions of Pounds	Number of Transactions	Number of Months
TRANSACTION VALUE	**15.10**	2.7	17	4

[1] Supply and demand tables in the *Current Market Data* section of this Report detail the numbers for each category.

DEFINITIONS

1. The **Exchange Value** is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the date indicated.
2. The **UF_6 Value** is Nuexco's judgment of the price at which spot and near-term transactions for significant quantities of natural uranium hexafluoride could be concluded as of the date indicated.
3. The **Conversion Value** is Nuexco's judgment of the price at which spot and near-term transactions for significant quantities of conversion services could be concluded in the secondary market as of the date indicated.
4. The **SWU Values** represent Nuexco's judgment of the price at which transactions for the sale of significant quantities of SWUs of stated origin for delivery in the specified time period could be concluded as of the date indicated.
5. The **Loan Use Charge Rate** is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the date indicated.
6. The **Transaction Value** is a weighted average price of recent natural uranium sales transactions. The calculation is based on prices paid in:
   a. Transactions closed within the previous three-month period for which delivery is scheduled within one year of the transaction date;
   b. At least ten transactions;
   c. Transactions involving a sum total of at least 2 million pounds U_3O_8 equivalent.

The sample time is extended as necessary to include these minima. Other currencies are converted to US dollars using conversion rates in effect on or near the transaction date.

DERIVATIONS AND COMMENTS

1. All Market Values are based on:
   a. Data from recently completed transactions.
   b. Data from pending transactions.
   c. Firm bids to buy or borrow, and firm offers to sell or lend.
   d. Prices purchasers or rates borrowers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy or borrow, and prices sellers or rates lenders have expressed a willingness to offer, but for which Nuexco is not aware of firm offers to sell or lend.
2. Prices associated with deliveries under old or renegotiated contracts or other than arm's-length transactions are not considered in the determination of these Market Values.
3. In the determination of the Conversion Value, Nuexco does not consider transportation charges other than those customarily provided by primary suppliers of conversion services.
4. The prices of conversion services or SWUs delivered under long-term contracts with primary suppliers are not considered in the determination of either the Conversion Value or SWU Value.
5. For the DOE SWU Values, Nuexco converts SWU prices at varying tails and product assays to equivalent SWU prices at a tails assay of 0.30 weight-percent U_{235} and a product assay of 3.0 weight-percent U_{235}, assuming feed costs corresponding to the Nuexco Exchange and Conversion Values determined as of the same date.
6. In calculating the Transaction Value, Nuexco does not account for the price of uranium delivered in connection with contracts which call for "market price" mechanisms. This exclusion applies particularly to contracts in which delivery prices are expressed as a function of future Exchange Values or any other indeterminant variable. Also excluded from the calculation are any other transactions in which the delivery price is defined in such a way that it cannot currently be determined.

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CURRENT MARKET DATA

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1] [2]

Country (currency)	per lb. U_3O_8 in Concentrates			per kg. U in Concentrates		
	This Month (Sep. 30, 1985)	Last Month (Aug. 31, 1985)	12 Months Ago (Sep. 30, 1984)	This Month (Sep. 30, 1985)	Last Month (Aug. 31, 1985)	12 Months Ago (Sep. 30, 1984)
Australia (dollar)	22.79	22.74	20.96	59.25	59.13	54.49
Belgium (comm. franc)	866.27	899.89	1,072	2,252	2,339	2,786
Canada (dollar)	21.98	21.78	23.05	57.15	56.63	59.92
Finland (markka)	91.90	94.45	110.06	238.92	245.55	286.14
France (franc)	130.61	135.82	162.04	339.56	353.11	421.26
FRG (mark)	42.94	44.46	53.05	111.64	115.58	137.91
Italy (lira)	29,154	29,840	32,901	75,795	77,576	85,535
Japan (yen)	3,458	3,793	4,280	8,991	9,862	11,126
Netherlands (guilder)	48.28	50.09	59.50	125.52	130.22	154.70
South Africa (rand)[2]	40.30	45.71	29.17	104.78	118.85	75.83
Spain (peseta)	2,611	2,613	2,959	6,789	6,795	7,693
Sweden (krona)	128.51	132.45	149.83	334.11	344.34	389.52
Switzerland (franc)	35.15	36.45	43.68	91.38	94.77	113.57
UK (pound)	11.37	11.43	14.05	29.55	29.72	36.52
US (dollar)	16.00	16.00	17.50	41.60	41.60	45.50

TRANSACTION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1] [2]

Country (currency)	per lb. U_3O_8 in Concentrates			per kg. U in Concentrates		
	This Month (Sep. 30, 1985)	Last Month (Aug. 31, 1985)	12 Months Ago (Sep. 30, 1984)	This Month (Sep. 30, 1985)	Last Month (Aug. 31, 1985)	12 Months Ago (Sep. 30, 1984)
Australia (dollar)	21.51	21.46	19.82	55.92	55.80	51.53
Belgium (comm. franc)	817.54	849.27	1,013	2,125	2,208	2,635
Canada (dollar)	20.74	20.56	21.80	53.93	53.45	56.67
Finland (markka)	86.73	89.14	104.09	225.48	231.74	270.61
France (franc)	123.27	128.18	153.24	320.46	333.25	398.39
FRG (mark)	40.53	41.96	50.17	105.36	109.08	130.42
Italy (lira)	27,514	28,161	31,115	71,531	73,213	80,892
Japan (yen)	3,264	3,580	4,047	8,486	9,307	10,522
Netherlands (guilder)	45.56	47.27	56.27	118.46	122.89	146.30
South Africa (rand)[2]	38.04	43.14	27.58	98.88	112.16	71.71
Spain (peseta)	2,464	2,466	2,798	6,407	6,412	7,275
Sweden (krona)	121.29	125.00	141.70	315.31	324.97	368.38
Switzerland (franc)	33.17	34.40	41.31	86.24	89.44	107.40
UK (pound)	10.73	10.79	13.29	27.89	28.05	34.54
US (dollar)	15.10	15.10	16.55	39.26	39.26	43.03

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[1] Calculated using currency exchange rates published in the *Wall Street Journal* on September 30, 1985.

[2] South African rand values (financial rand) based on rates published September 27, 1985.

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CONVERSION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1] [2]

Country (currency)	per lb. U as UF_6			per kg. U as UF_6		
	This Month (Sep. 30, 1985)	Last Month (Aug. 31, 1985)	12 Months Ago (Sep. 30, 1984)	This Month (Sep. 30, 1985)	Last Month (Aug. 31, 1985)	12 Months Ago (Sep. 30, 1984)
Australia (dollar)	2.28	2.27	1.20	5.02	5.01	2.64
Belgium (comm. franc)	86.63	89.99	61.24	190.98	198.39	135.00
Canada (dollar)	2.20	2.18	1.32	4.85	4.80	2.90
Finland (markka)	9.19	9.45	6.29	20.26	20.82	13.87
France (franc)	13.06	13.58	9.26	28.80	29.94	20.41
FRG (mark)	4.29	4.45	3.03	9.47	9.80	6.68
Italy (lira)	2,915	2,984	1,880	6,427	6,578	4,145
Japan (yen)	345.87	379.33	244.56	762.51	836.27	539.16
Netherlands (guilder)	4.83	5.01	3.40	10.64	11.04	7.50
South Africa (rand)[2]	4.03	4.57	1.67	8.89	10.08	3.67
Spain (peseta)	261.14	261.35	169.09	575.71	576.18	372.78
Sweden (krona)	12.85	13.25	8.56	28.33	29.20	18.88
Switzerland (franc)	3.51	3.65	2.50	7.75	8.04	5.50
UK (pound)	1.14	1.14	0.80	2.51	2.52	1.77
US (dollar)	1.60	1.60	1.00	3.53	3.53	2.20

SWU VALUES AND UF_6 VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1] [2]

Country (currency)	DOE SWU Delivery by the End of FY86 (September 30, 1985)	Non-DOE SWU Delivery by the End of CY86 (September 30 1985)	UF_6 Value per kg. U in UF_6 This Month (September 30, 1985)	UF_6 Value per kg. U in UF_6 Last Month (August 31, 1985)
Australia (dollar)	121.08	111.11	63.39	63.26
Belgium (comm. franc)	4,602	4,223	2,409	2,503
Canada (dollar)	116.77	107.16	61.13	60.59
Finland (markka)	488.23	448.02	255.60	262.69
France (franc)	693.88	636.73	363.27	377.76
FRG (mark)	228.13	209.34	119.43	123.65
Italy (lira)	154,883	142,128	81,086	82,991
Japan (yen)	18,374	16,861	9,619	10,550
Netherlands (guilder)	256.49	253.37	134.28	139.31
South Africa (rand)[2]	214.11	196.47	112.09	127.14
Spain (peseta)	13,873	12,730	7,262	7,269
Sweden (krona)	682.73	626.51	357.43	368.38
Switzerland (franc)	186.73	171.35	97.76	101.39
UK (pound)	60.39	55.42	31.62	31.80
US (dollar)	85.00	78.00	44.50	44.50

[1] Calculated using currency exchange rates published in the *Wall Street Journal* on September 30, 1985

[2] South African rand values (financial rand) based on rates published September 27, 1985.

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NUEXCO

CURRENT MARKET DATA

RECENT TRANSACTIONS[1]

Uranium Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U_3O_8 equivalent)	Approximate Price as Percent of Current Exchange or UF_6 Value	Seller	Buyer	Remarks
3571	1985	50-100	94	European Producer	European Utility	
3570	1986	50-100	less than 101	Trader	European Utility	UF_6.
3569	1985	101-300	98	US Fabricator	US Utility	UF_6.
3568	1985	50-100	96	US Producer	US Producer	Market-related price.

Secondary Market Conversion Services

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U equivalent)	Approximate Price as Percent of Current C.V.	Seller	Buyer	Remarks
3572	1986	101-300	94	US Utility	US Utility	

Enrichment Services
Secondary Market Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity[2] (thousands of SWUs)	Approximate Price[3] as Percent of Current SWU Value[4]	Seller Group	Buyer Group	SWU Origin	Remarks
3573	1986	less than 50	100	European Entity	European Utility	DOE	
3567	1986	less than 50	R[5]	European Entity	R[5]	Eurodif	
3563	1986	less than 50	100	Trader	US Utility	DOE	

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[1] Transactions listed are not limited to those in which Nuexco was involved, but also include others of which Nuexco is aware.
[2] If tails assay is unknown or unspecified, Nuexco's calculation of SWU quantity assumes 0.30 w/o tails assay.
[3] Price is not normalized to 0.30% tails assay.
[4] Refers to SWU Value that corresponds to SWUs included in transaction. When prices and SWU values are expressed as discounts (e.g., X dollars less than DOE's USEC base price at time of delivery), the percentage refers to the ratio of the *discounts*, not the ratio of the prices.
[5] The notation *R* means that Nuexco either does not know, or that Nuexco has restricted that information to protect client confidentiality.

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URANIUM SUPPLY
(September 30, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Spot or Near-term[2]	Intermediate or Long-term	Remarks
Available for Sale:			
ACTIVE			
2654*	300	700 per year	UF_6
2711*	175	—	U_3O_8 or UF_6
2728	200	500 per year	1986-90
2746*	180	—	UF_6e
2763*	40	—	
2774*	200	—	
2793*	500	—	
2814	500	500	UF_6
2263*	—	400 per year	1987 on
2625	—	250 per year	1987-89
2680	—	250 per year	1986-92
2778*	—	220 per year	1987-90
TOTAL:	2,095		
INACTIVE			
1860	250	1,000 per year	UF_6
2335	275	—	
2336	250	250 per year	1985-94
2389*	75	75 per year	1986-90
2483	545	—	
2553	300	—	
2705A*	200	—	UF_6
2777*	250	—	
2804*	100	—	
2297	—	200 per year	1986-89
TOTAL:	2,245		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2191, 2623, 2668, 2736.

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CURRENT MARKET DATA

URANIUM DEMAND
(September 30, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Spot or Near-term[2]	Intermediate or Long-term	Remarks
Inquiries to Purchase:			
ACTIVE			
2743*	300	—	
2748*	200	—	
2775	200	—	
2784	100	—	
2785*	300	—	U_3O_8 or UF_6
2217	—	1,000 per year	1989-95
2507	—	600	1987-89
2681*	—	500 per year	UF_6 or U_3O_8; 1987-88
2741	—	600	
2753*	—	200	1987
2758	—	500	UF_6
2796*	—	175 per year	1988-92
TOTAL:	1,100		
INACTIVE			
2548	290	—	
2586*	300	300 per year	1987-90
2676*	200		
2718	250	350	
2767*	200	—	UF_6
2643	—	150 per year	1987 on
2733*	—	500 per year	1987-95
TOTAL:	1,240		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2414, 2576, 2590, 2636, 2694, 2757.

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LOAN SUPPLY AND DEMAND
(September 30, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Within 1 Year	Beyond 1 Year	Remarks
Available for Loan:			
ACTIVE			
1938	2,000		UF_6
TOTAL:	2,000		
INACTIVE			
2036	500		
2483	550		
2667	800		
TOTAL:	1,850		
Inquiries to Borrow:			
ACTIVE			
2606	500		
TOTAL:	500		

*New or revised since last month.
[1] Measured from the date of this Report.
Projects removed since last month: 2469.

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CONVERSION SUPPLY AND DEMAND
(September 30, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U as UF_6) Within 3 Years	Beyond 3 Years	Remarks
Available for Sale:			
ACTIVE			
2051*	100	—	
TOTAL:	100		
Inquiries to Purchase:			
INACTIVE			
2587*	35	—	
2623*	1,000	—	
2709*	50	—	1986-91
2724	—	375	1989-93
TOTAL:	1,085		—

*New or revised since last month.

[1] Measured from the date of this Report.

Projects removed since last month: 2511, 2529, 2576, 2617, 2725.

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SWU SUPPLY AND DEMAND
(September 30, 1985)

	Delivery Period[1] (Thousands of SWUs)		
Nuexco Project Number	Spot or Near-term[2]	Intermediate or Long-term	Remarks
Available for Sale:			
ACTIVE			
2410A	350	—	
2607	200	—	
2705*	350	—	
2571	—	55	1987
TOTAL:	900		
INACTIVE			
2359	—	200	
2378	—	120	1988
2510	—	50	
2652	—	25	1986
TOTAL:	0		
Inquiries to Purchase:			
ACTIVE			
2400		150	1987-90
2519	—	30 per year	1987 on
2578*	125	—	
2742	10	—	
2747*	—	150	1988-89
2752*	65	—	
TOTAL:	200		
INACTIVE			
2500		170	1988
2512		15 per year	1987 on
TOTAL:	0		

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*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes SWUs deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2595, 2597, 2624, 2668, 2684

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RAW MATERIALS

THE CIGAR LAKE PROJECT

Introduction

Canada's Cigar Lake uranium deposit, the largest high-grade uranium deposit ever discovered, is located in northern Saskatchewan, 115 kilometers northeast of the Key Lake mine. Continuing the pattern that has seen each major uranium discovery in the province surpass the previous ones, an unparalleled combination of high grade and resource size make Cigar Lake the most exciting uranium discovery in recent years. Preliminary production plans call for annual output of 12,000,000 pounds U_3O_8, approximately the same as that of Key Lake, presently the world's largest uranium production center, but Cigar Lake has the potential to surpass that level at will.

The Cigar Lake uranium deposit was discovered May 9, 1981; the very first hole drilled revealed high-grade uranium associated with nickel-cobalt arsenides. Each season's drilling revealed additional reserves. Drill-indicated reserves in the main mineralized pod have been calculated at 285 million pounds of an average grade of 14 percent U_3O_8, and inferred reserves in its western extension total 100 million pounds of an average grade of 4.7 percent U_3O_8. Technically, reserves are based on a 0.1-percent cutoff grade, but the estimates are insensitive to the choice of cutoff grade. The deposit is at an average depth of 430 meters, has an indicated length of at least 1,850 meters, and remains open to the west.

The ore deposit and immediate surrounding property are controlled by the Cigar Lake Mining Corporation (CLMC), a joint operating company formed May 16, 1985. Ownership of CLMC is the same as in the Waterbury Lake joint venture: Saskatchewan Mining Development Corporation (SMDC), 50.75 percent; Cogema Canada Limited, 32.625 percent; Idemitsu Uranium Exploration Canada Ltd., 12.875 percent; and Corona Grande (a wholly owned subsidiary of Cogema), 3.75 percent (acquired from Reserve Oil & Minerals Corporation). Operating out of Saskatoon, Saskatchewan, CLMC's primary function will be to identify a suitable mining and milling program for the deposit. Figure 2 shows the location of the Cigar Lake deposit.

Exploration Events

The Cigar Lake discovery climaxed the series of geologic and exploration events in Saskatchewan that began in the late 1960s. Early exploration conducted by the Canadian Kelvin group included geophysical and geotechnical surveys over a large portion of the vast 900,000-acre Waterbury Lake claim block. A few anomalous areas had been identified, but not defined, on the Waterbury Lake acreage. Asamera Oil Corporation became the project operator in 1976. Asamera made a limited contribution to regional exploration of the lands during the next two and one-half years, conducting geological surveys and drilling several hundred holes. Their effort culminated in the discovery and delineation of the Dawn Lake deposits.

The original Canadian Kelvin claim block was later divided into three separate blocks to accommodate the split of the joint venture group. Cogema Canada Limited (then SERU Nucleaire) acquired a 32.625-percent interest in the 230,000-acre Waterbury Lake block in late 1979 and became operator of the project in January 1980. Cogema immediately renewed exploration efforts throughout the claim block. Previously determined anomalies, including those at Cigar Lake, received top priority and exploration work began in those areas.

One such anomaly was situated on an arm of Waterbury Lake near Cigar and Tibia Lakes. Cogema detailed the area with airborne and ground geophysical surveys, using the most advanced instruments available for deep penetration of the cover rocks. At least two strong graphite gneiss conductor zones, trending almost due east-west, were identified in the basement rocks at depths exceeding 400 meters. Geophysical methods also determined that each zone is closely associated with prominent northeast-southwest and east-west faulting. One zone crosses the south end of Cigar Lake; the other, about one kilometer (km) to the north, tends to parallel the south shore of Tibia Lake. The results of further geochemical surveys indicated the existence of radiometric anomalies in sediments of the three nearby lakes, suggesting that radon gas, originating from deep-seated uranium mineralization, may have reached the surface by ascending along zones of weakness created by the faulting.

Cogema first identified the area for evaluation by drilling based on an exploration model. The model was formulated by analyzing information acquired through a variety of techniques, including the adaptation of certain characteristics of earlier models developed (both *a priori* and *ex post facto*) for deposits at Key Lake, Dawn Lake, Midwest Lake, and others. The first hole drilled on the Cigar Lake prospect (the 15th hole drilled by Cogema on the Waterbury Lake claims) was collared in April 1981. Mineralization was encountered on May 9 at a depth of 428 meters. The hole penetrated an ore zone measuring 13.1 meters thick with an average grade of 1.82 percent U_3O_8. Fourteen of the next 16 holes drilled encountered ore zones of up to 17 meters thick and at grades of 7.20 percent to 24.08 percent U_3O_8.

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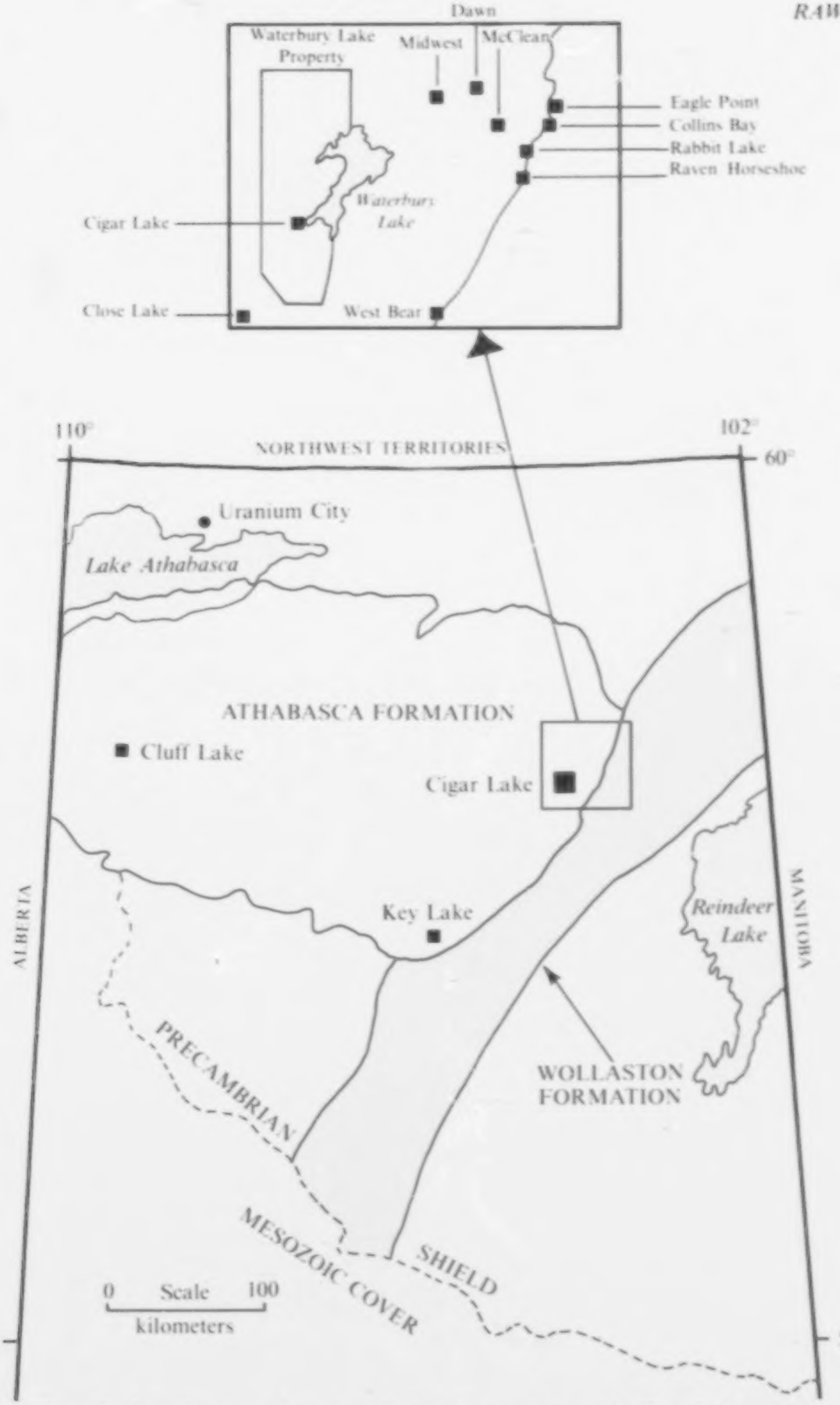
Dawn
Waterbury Lake Property
Midwest
McClean
Eagle Point
Collins Bay
Rabbit Lake
Raven Horseshoe
Waterbury Lake
Cigar Lake
Close Lake
West Bear
110°
102°
NORTHWEST TERRITORIES
60°
Uranium City
Lake Athabasca
ATHABASCA FORMATION
Cluff Lake
Cigar Lake
Key Lake
ALBERTA
MANITOBA
Reindeer Lake
WOLLASTON FORMATION
PRECAMBRIAN
SHIELD
MESOZOIC COVER
0 Scale 100
kilometers
55°

Figure 2. Location map of northern Saskatchewan, showing the Cigar Lake uranium deposit and others in the district.

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Cogema also pursued the anomaly at Tibia Lake, with considerably different results. The exploration model generated for the prospect showed many of the same favorable characteristics as the model for Cigar Lake. Fifteen holes were drilled, of which eleven were barren and four were mineralized. The most significant mineralization encountered was a zone at a depth of 470 meters. It was four meters thick and averaged about 1 percent U_3O_8. Overall, the mineral zone was found to be erratic in occurrence within a drilled-out area of 150 meters by 50 meters. The Tibia Lake prospect has been temporarily abandoned in favor of other promising targets in the vicinity.

The Ore Deposit

The Cigar Lake deposit was almost completely delineated by the end of the 1984 drill campaign. Some additional drilling was done in early 1985 to complete delineation of the main zones of mineralization. (Figures 3 and 4 show the drilling of an incline hole and preparation for winter drilling, respectively.) A total of 165 holes were drilled on the deposit over its east-west strike length of 2,000 meters and width of 25 to 105 meters. Uranium mineralization appeared in 111 holes, highlighted by a number of extremely high-grade ore intercepts. For example, the core from one hole assayed an average 37.70 percent U_3O_8 over a thickness of 19 meters. (Figure 5 shows core samples.) Further drilling on the ore deposit probably will not be required, except to provide additional information in support of development efforts.

Figure 3. Drilling an incline hole.

Figure 4. Drill rig prepared for winter drilling.

The ore body shows good continuity throughout the entire length. However, it is divided into three main zones of mineralization, a circumstance conducive to extraction purposes. The most prolific portion, ore zone 122, lies at the eastern end between drill lines 7+00E and 10+50E. That area of 350 meters along strike contains approximately 165 million pounds U_3O_8 at a grade of 20 percent to 25 percent. The next important portion, comprised of zones 3 and 4, lies between drill lines 4+00E and 7+00E, an area of 300 meters containing approximately 120 million pounds U_3O_8. Figure 6 shows the interrelationship of the areas.

The third area of interest includes the entire western portion of the deposit from drill line 4+00E to drill line 7+00W, a distance of 1,100 meters. The ore body varies from one to four meters in thickness to the west and the

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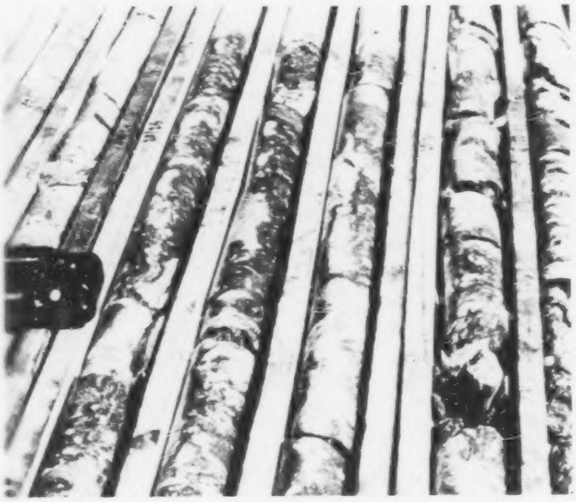

Figure 5. Drill core samples.

grade averages 4.7 percent U_3O_8. The zone contains approximately 100 million pounds of inferred ore. Present plans do not include the western extension in an exploitation schedule. However, eventual exploitation should not be ruled out at this early stage of project planning.

Ore body continuity primarily pertains to basal characteristics of the mineralized zone. The basal contact is the unconformity; the ore is situated on top of the basement ridge which varies in height from three meters to thirty meters. Thus, the deposit is 420 to 440 meters in depth, relatively flat-lying, or concave over the full extent of 2,000 meters along the ridge. The ore thickens in the primary zones to about 20 meters, and the upper ore limit is about 410 meters from the surface.

The unconformity separates metasediment basement rocks of Lower Proterozoic age from overlying Athabasca sandstone of Middle Proterozoic age. Most ore occurs in the lower Athabasca sandstone, representing the first major deposit in the district where sandstone is

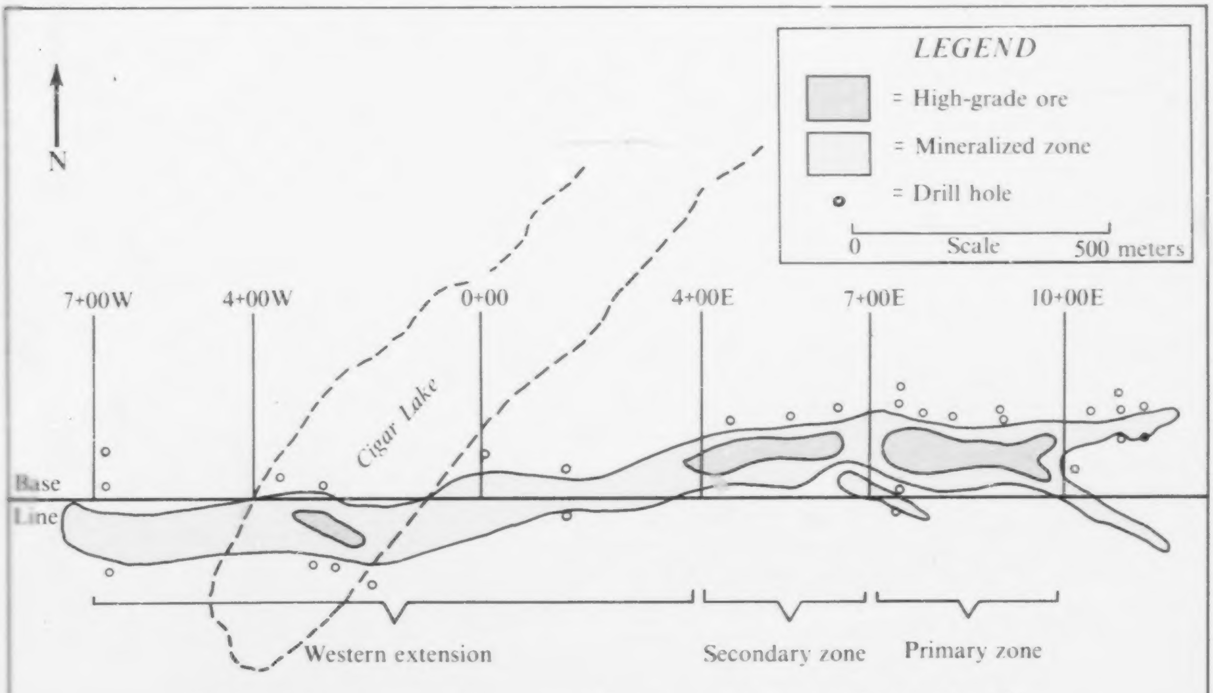
N
LEGEND
▨ = High-grade ore
☐ = Mineralized zone
○ = Drill hole
0
Scale
500 meters
7+00W
4+00W
0+00
4+00E
7+00E
10+00E
Cigar Lake
Base Line
Western extension
Secondary zone
Primary zone

Figure 6. Plan map of the Cigar Lake uranium deposit showing width of mineralization along the 2,000-meter east-west trend.

the principal host rock. Mineralization in the basement rocks is limited to inconsistent pods along the unconformable contact. It may thicken to two or three meters locally, and develop strongly along faults, veinlets, and fracture zones. High-grade ore (in excess of 50 percent) is common in this environment. However, the tonnage in the basement rocks is relatively small and will not be an important part of the overall project economics.

Additional mineralization occurs as "perched pods" in the highly altered sandstone and quartz zones of the upper sandstone sequence. The mineralization has accumulated along fault zones where alteration (hydrothermal activity) was more intense and the environment more conducive to mineral deposition. Such zones may occur up to 200 meters above the unconformity. The mineral content averages about one percent to four percent U_3O_8. The relatively low grade and limited tonnage in the perched pods make it unlikely that they will be mined. Figure 7 is an idealized cross-section through the ore deposit illustrating these features.

Mineralization

The mineralizing process at Cigar Lake was directly associated with extensive hydrothermal solution activity resulting in rather complete rock alteration. The mineralization is the center-zone of the alteration process. It was precipitated (or recrystallized) in the Athabasca sandstone from migrating fluids in the presence of a reducing environment. This process was associated with the underlying presence of the graphitic gneiss conductor in the basement rock. Intense alteration has caused depletion of graphite from the gneiss zone, affecting basement rock characteristics as much as 100 meters below the unconformity. The Athabasca sandstone is altered at least 200 meters above (Figure 7).

The extent of rock alteration is a measure of the clay content. The mineralized zone and the massive clay which completely encloses it has a clay content of 30 percent to 80 percent. It is light grey to dark green and generally consists of illite and iron-rich kaolinite, both associated with siderite (areas 1 and 2 in Figure 7). The zone is soft and may prove to be totally incompetent for conventional mining procedures. Immediately above that zone is a halo of alteration in the lower Athabasca sandstone unit, containing about 30 percent clay. Overall, the zone is friable and locally unconsolidated due to the removal of quartz cement through the alteration process (area 3). Further above lies a broad band of alteration recognized as the quartz zone, wherein the sandstone has undergone irregular but extensive silicification. The clay content is essentially nonexistent throughout the zone; the rock is brittle, hard, and abrasive (area 4). The last zone consists of grey sandstone with further loss of siliceous cement and increasing clay content. The sandstone is grey in color because of the presence of finely disseminated iron sulfides (area 5). The zone is soft and locally unconsolidated. Above that zone, the Athabasca is mostly unaltered, appearing pink in color (area 6).

Alteration in the basement rock was even more extensive. The massive clay zone at the unconformity and underlying the ore deposit is 80 percent clay consisting of alumino-magnesian chlorites and magnesian illite (areas 1 and 2). The alteration process was so complete that the original texture of the metasediments was destroyed. The clay content decreases with depth, becoming grey to green illite-chlorite (area 3a). The original rock texture is preserved near the final stages of alteration at a depth of about 100 meters below the unconformity (area 8).

The mineralizing process, which appears to have transpired in three distinct phases of accumulation, occurred along with the alteration process. Phase 1 is the most important, representing the bulk of all uranium present. Uraninite (uranium oxide) occurs as the principal metal present in the main ore deposit at the unconformity. The uranium content is extremely high, commonly exceeding 50 percent U_3O_8 over a thickness of one meter to 19 meters. Associated minerals present include nickel and cobalt arsenides. The host rock is the lower Athabasca Sandstone unit; the gangue minerals are mainly iron and magnesian illites.

Pitchblende (uranium oxide) is the main uranium mineral deposited during Phase 2. It is associated with copper sulfides in the iron-rich kaolinite of the massive clay zone and the alumino-magnesian chlorites in the basement rock, and is possibly the first evidence of recrystallization and remobilization of the uranium (see Figure 7).

Phase 3 included the introduction of coffinite (uranium silicate) and pitchblende in close association with nickel-cobalt arsenides. These were disseminated throughout much of the deposit, especially along the mineral trend, in veinlets and along faults in the basement. Phase 3 is essentially remobilized mineralization making up most of the mineralization present in the perched pods of the upper altered formations. Overall, the associated metal values tend to be rather consistent: 0.70 percent copper; 1.16 percent lead; 0.04 percent zinc; 0.14 percent molybdenum; 0.96 percent nickel; 0.15 percent cobalt; 1.67 percent

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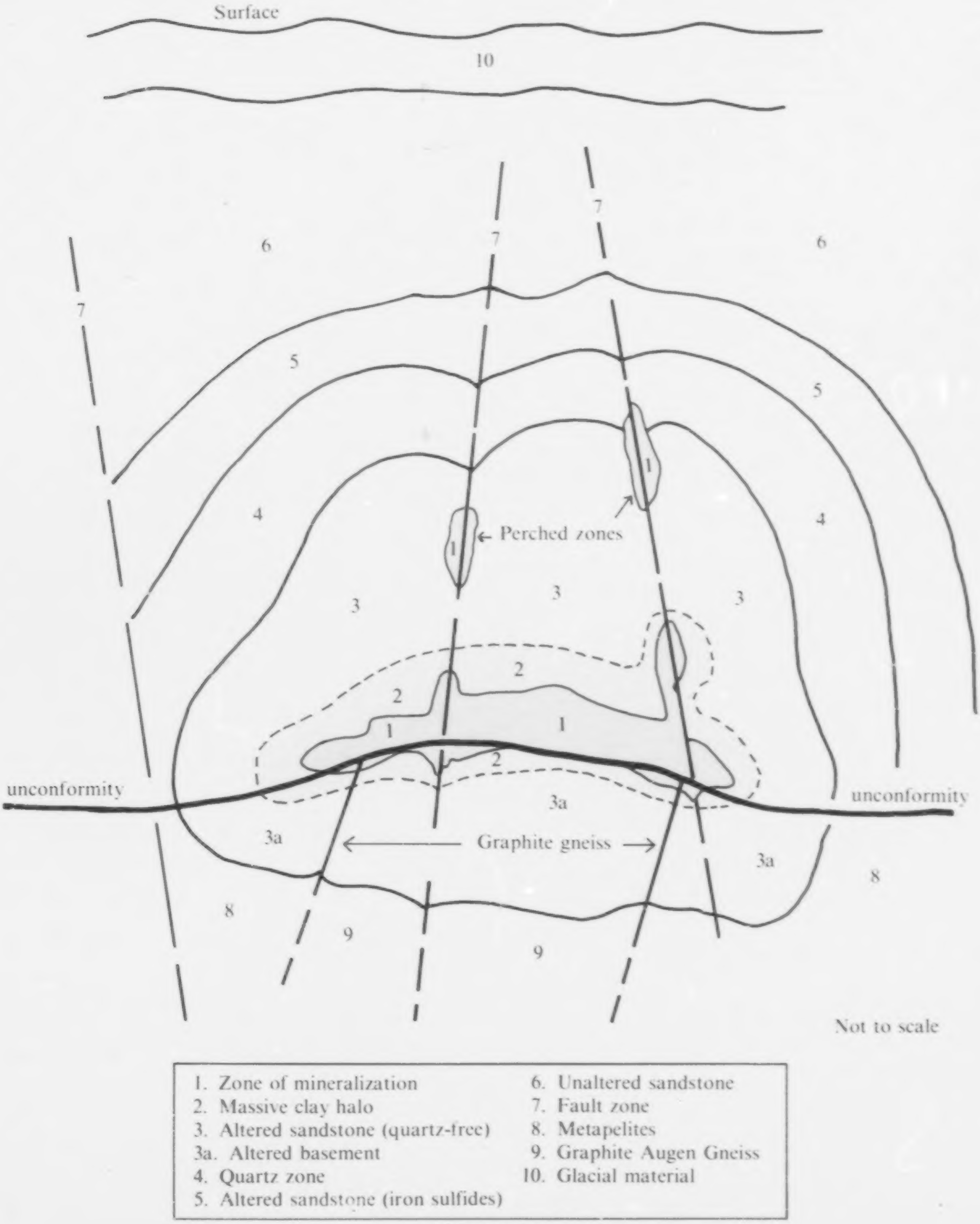
Figure 7. Typical north-south cross-section through the Cigar Lake uranium deposit. Note the relationship of altered zones to mineralization.


Surface
10
7
7
6
6
7
5
5
4
4
1
1
Perched zones
3
3
3
2
2
1
1
2
unconformity
unconformity
3a
3a
3a
Graphite gneiss
8
8
9
9
Not to scale

1. Zone of mineralization
2. Massive clay halo
3. Altered sandstone (quartz-free)
3a. Altered basement
4. Quartz zone
5. Altered sandstone (iron sulfides)
6. Unaltered sandstone
7. Fault zone
8. Metapelites
9. Graphite Augen Gneiss
10. Glacial material

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arsenic. It is likely that none of the companion minerals occur in percentages high enough to be considered for recovery as a by-product to uranium. That option remains open, however, at least during the project planning stage.

Project Development

CLMC was established to formulate the best development method for exploitation of the Cigar Lake deposit. The present staff consists of the president, an accountant, a secretary, four mining engineers, one process engineer, and one environmental scientist. Each joint venture partner is represented. The staff performs studies of recovery plans based on existing technology; new and innovative ideas such as mining by remote control also are under consideration. In dealing with such high-grade ore, personnel safety and preservation of the environment take on even more importance than usual.

Project development probably will be timed to exploit two expected events:

1. The strengthening of the uranium market, which is anticipated in the early 1990s;
2. The phase-out of production at Key Lake, which could happen before the end of this century.

CMLC's flexible development schedule for Cigar Lake would allow for a one to three-year advance or delay of the project should unforeseen events require.

CLMC has established a tentative annual production target of 12 million pounds U_3O_8, based on mining and milling about 100 tonnes of ore per day at an average grade of 15 percent U_3O_8. A high-cost, large-capacity, conventional mine and mill complex will not be required. CLMC's studies indicate that project development can be accomplished primarily through the modification and application of existing technology. Improvements in equipment and techniques can be applied when developed, but they probably will not be necessary, even in areas of radioactivity that may be encountered. The CLMC staff has the advantage of drawing on experience in other relatively high-grade operations. For example, Phase I at Cluff Lake processed an average grade of 35 percent U_3O_8, so it provided ample practical experience for the special materials handling and radiological controls problems associated with high-grade ore. Some basic measures that will be taken to reduce and control exposures are:

1. Pressurized cabs for mining equipment;
2. Air filters for miners;
3. Protective clothing;
4. Shielded equipment (e.g., trucks, mill equipment);
5. Ventilation network design based on once-through and age of air techniques;
6. Back-up ventilation systems in case of breakdowns;
7. Radiation protection training for the workers;
8. Intensive monitoring of both worker exposure and site radiation levels using a range of measuring instruments.

CLMC has identified four areas of primary concern that must be resolved before a final development plan can be submitted for approval.

1. **Rock properties:** The properties of the five altered zones differ in compressive strength and hydraulic conductivity, each of which is directly related to clay content. At Cigar Lake, the high clay content of a rock zone produces lower compressive strength, reduced permeability, and a low competency level. The rock tends to be forced into any opening, such as a drill hole or a mined opening. Numerous problems are anticipated with conventional underground mining in the altered formations; thus, some modification of conventional mining techniques will be required.

2. **Groundwater:** The hydraulic conductivity (permeability coefficient) of the altered rock is known to be low. The existing information regarding groundwater suggests that structural and alteration events have somewhat isolated the area of interest from normal recharge conditions. If so, favorable conditions exist for dewatering an access shaft site and the ore deposit before mine development begins. Regardless, the implementation of a dewatering program which would require the drilling of strategically located wells within the isolated area is now under study. It appears that extremely large volumes of water would have to be pumped to accomplish the dewatering task. It may prove to be an enormous and costly task, one that would affect the selection of a mining method.

3. **Radiation control:** The high-grade ore at Cigar Lake presents a new challenge in radiation control, even considering similar problems once encountered in the mines at Key Lake and Cluff Lake. (The most significant difference between Cigar Lake and the other deposits is that Key Lake and Cluff Lake are both open-pit mines; average ore grades there, while high, are still lower than at Cigar Lake, which will be mined by underground methods.) A principal hazard to underground uranium miners is internal exposure to alpha and beta radiation emitted from airborne radon daughter products and external exposure to ionizing radiation from gamma rays. (Radon daughters concentrate in lung tissue, while gamma rays irradiate the whole body.) Some radon gas is present everywhere in the atmosphere because uranium, being a

very common element, is present in at least trace amounts virtually everywhere. Usually the radon gas disperses harmlessly into the atmosphere. However, where uranium is present in large concentrations, the level of radon gas (and its daughters) in the atmosphere is far higher and can be hazardous to health. For occupational safety purposes, radon gas exposure is measured in *working level months*, derived as the product of average level of radon gas and the equivalent number of exposure months. The immediate problem at Cigar Lake is to anticipate the level of radiation at each phase of mining and milling. Subsequently, methods for controlling the radiation, such as shielding or containerization, can be implemented. Operational data available from working models adapted and applied at Key Lake and Cluff Lake have indicated that accurate predictions of radiation levels, and acceptable engineering solutions, can be achieved. Studies continue on radiation control problems at Cigar Lake, the results of which will determine the final development plans adopted by CLMC.

4. **Clay content:** In addition to lower strength and competency levels, the high clay content in the ore zone and surrounding altered rocks also compounds ore and waste handling problems. Underground, the clay-bearing material tends to build up on walls of ore cars, chutes, transfer points, and storage bins. Manual labor is required to normalize the flow of ore, and in so doing, the workers may be exposed temporarily to excessive levels of radiation. In addition, mechanized equipment used for moving ore and waste from point to point on the surface becomes coated with clayey material, requiring continual cleaning by shovelling or washing. In the latter case, a separate slimes settling and handling system may be required. Radiation exposure levels can be hazardous to workers in either case. The Cigar Lake project will have a number of clay-induced problems, many of which will need to be eliminated during the pre-engineering and planning processes.

Mine Planning

The final mining plan probably will combine conventional procedures, augmented by techniques designed to overcome the special circumstances of high-grade ore and unstable ground conditions. Conventional mining methods are favored because of experience and equipment availability. Access to the ore deposit will probably be through a conventional shaft sunk in barren ground with haulageways driven into or adjacent to the area of mineralization. Any attempt to mine the deposit strictly by conventional methods (e.g., stope or room and pillar), where miners must work close to high-grade ore, could create a difficult radiation control problem. In addition, rock instability would be a constant problem, necessitating the dewatering of all ground adjacent to the mine area, as well as either grouting or freezing the ground prior to initial excavation work. Freezing is a viable technique for shaft sinking, but freezing and then mining the ore deposit is a more difficult task. Grouting also has drawbacks; it is a costly process, and may be ineffective because the high clay content and low hydraulic conductivity of the rock would inhibit penetration.

Aside from conventional mining methods, there are four basic procedures under consideration for exploiting the Cigar Lake deposit:

1. **Raise borehole mining** can be implemented through the full use of conventional techniques. Access to the ore deposit is through barren ground, with development drifting completed above and below the ore zone. Raise boreholes are installed between the working drifts. Upreaming through the ore zone with a large-diameter bit drops the cuttings to the lower drift for loading and transporting to the surface; the fine material is slurried to the surface. Special ventilation controls the flow of air away from the loading area, which is the only location where miners are in close contact with ore. Miners could be further removed from contact with broken ore if remote-controlled mechanized units were used. Such units are already available for most phases of mining. Dewatering or freezing may be required for ground stability prior to actual mining of ore.

2. **Hydromilling mining** requires an access shaft and development drift to the area above the ore zone. A patented Hydrofraise tool occupies the drift as a metal frame designed to prevent caving while allowing mining. It is equipped with a vertical cutting drum which is used to drill through the ore zone, leaving a rectangular-shaped hole measuring about 1.5 meters by 2.5 meters. Cuttings are slurried from the cutting face to the surface for further processing. The Hydrofraise tool is advanced after each cut to complete mining of a predetermined slice. As each slice is made, it is immediately backfilled with concrete to prevent caving. The advantages of this remote-controlled mining method include slurry pumping to the surface and radiation protection for the miners.

3. **Borehole hydraulic mining** is a technique developed and tested by Flow Industries. The concept is based on down-the-hole erosion of an ore zone by the washing action of a high-pressure stream of water. The jet stream is created by a high-pressure nozzle attached to a compartmentalized pipe stem lowered through a drill hole

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into an ore zone. One compartment carries the water for jetting, another for pumping the cuttings to the surface. The nozzle can be turned 360 degrees and raised or lowered to mine all ore within a zone of influence. Effectiveness of the tool depends primarily on the character of the rock; the jet stream can be adjusted to cut and erode almost any type of rock, but with varying degrees of efficiency. The drilling and pumping units could be modified for underground access from a drift above the ore deposit if desired. This mining method would allow almost complete radiation control, but disadvantages include potential problems stemming from fragmentation of the high clay zones, control of cavern geometry, and possible ore losses due to uncontrolled caving.

4. **In-situ leach mining** has limited potential at Cigar Lake, but it is nevertheless under serious study. Obvious problems include the fact that the clay ore zone is relatively impermeable and may not accept induced lixiviant at an exposure rate required for proper leaching. Thus, recovery levels may be unacceptably low. The technique offers interesting advantages, however. The full range of equipment used for leaching could be adapted for underground operations from a drift above the ore zone, minimizing underground development work. Manpower requirements and material handling would be at a minimum, reducing the radiation hazards for miners. In addition, the disposal of waste material would be greatly eased and conventional backfill would be obviated. The planning committee may undertake in-situ leach testing in another location with similar geology to better demonstrate the viability of the technique under those conditions.

Pre-Development Schedule

With the formation of CLMC, the partners took the first step toward project development. The project will be operated by CLMC, while the joint owners will retain full financial and market responsibility. The organization is structured along the lines of the successful Key Lake Mining Corporation. At present, the CLMC staff is continuing studies dealing with environmental, radiation, geotechnical, and mine design concerns. Each study is a prerequisite for regulatory approval.

CLMC has declared 21 square kilometers surrounding the deposit as the area of operational control for the project, thereby isolating the Cigar Lake project from other activities on the remaining Waterbury Lake claim block. The completion of required studies will be followed by public review, after which CLMC presumably will receive permission from appropriate provincial and federal government agencies to proceed with project development. The 21-square-kilometer plot will probably be reclassified by the government from its present temporary-claim status to a lease extending through the project life. Technically, the lease serves as an instrument of conveyance with CLMC assuming full obligation to confine operations within the designated area, and to perform according to the terms and conditions established by provincial agencies. Upon accepting the lease, CLMC becomes obligated to operate the project under environmental and regulatory requirements of federal and provincial law.

The CLMC pre-development program is tentatively scheduled to complete all studies and secure regulatory approvals by the beginning of 1988. Test mining will continue until the end of 1989. Final development and feasibility planning will begin in 1987 and run through 1990, while actual mine development will begin about mid-1990 and continue until initial production begins about mid-1993. The schedule must remain flexible, so that final regulatory approvals can be secured and timing with future market opportunities can be exploited.

Acknowledgement

This article was made possible through the cooperation of CLMC. Additional information and concepts came from review of a paper presented on October 2, 1985 at the Atomic Industrial Forum Symposium, Santa Fe, New Mexico, and entitled: "The Cigar Lake project—concepts for mining high grade unconformity uranium ores, Athabasca Basin," prepared by Mr. Jean-Pierre Fouques, Chief Geologist, Cogema, and Mr. J. E. Tosney, Vice-President and Manager, Mining & Engineering, SMDC. Opinions, conclusions, and any errors are Nuexco's.

APPENDIX

Regional Geology

The uranium deposits of northern Saskatchewan have several common characteristics. Each deposit is associated with an unconformity separating two distinct rock types, and the source of mineralization is essentially the same. The rocks below the unconformity consist of Archean and Aphebian crystalline basement rocks belonging to the Wollaston Fold Belt series. Archean rocks include granites, biotite, and graphitic gneisses, as well as highly metamorphosed and altered sediments dated about 2,500 million years (m.y.). The fine-grained metasediments contain large quantities of graphite, often distinguishable as intercalated graphitic horizons. The graphitic gneiss zones contain abnormal amounts of uranium. The full rock sequence was folded, faulted, and meta-

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morphosed during the final stages of the Kenoran Orogeny, dated about 2,480 m.y.

Aphebian rocks of Lower Proterozoic age (about 1,850 to 1,700 m.y.) were deposited on the highly altered and eroded Archean surface as a thick series of sandstones, conglomerates, siltstones, and limestones, dispersed with a variety of volcanic rock flows. The sequence was subsequently highly metamorphosed, faulted, and infolded with Archean rocks during the Hodsonian Orogeny (about 1,735 m.y.). The metamorphic series consist of chlorite and graphitic gneisses, both of which are known to contain anomalous uranium mineralization. The upper portion of the Aphebian rocks was subjected to extensive weathering and alteration forming at the surface, the regolith mantle that varies in thickness from less than a meter to tens of meters. The regolith developed during the last stages of the Hodsonian Orogeny.

In unconformable contact with the Aphebian rocks lies the Athabasca Formation of Helikian age (Middle Proterozoic, over 1,350 m.y.). The Athabasca Formation consists primarily of quartzites derived from the upper portion of Aphebian rocks. It contains basal conglomerates and well-sorted and evenly bedded quartzites. The formation is about 1,650 to 1,700 meters thick in the center of the basin, thinning rapidly eastward to an erosional edge over the Wollaston Fold Belt series.

The source of mineralization probably started as abnormal amounts of uranium included in sediments of the Wollaston Fold Belt series, and consequently in the Athabasca Formation. Concentration of mineralization began with diagenesis of the Athabasca Formation and conditions of intense alteration and hydrothermal activity following Helikian deposition. Uranium was taken into solution by hydrothermal action, and later recrystallized as a reoccurring process. It eventually formed highly concentrated mineralization in the favorable host environment of the lower Athabasca Formation (and the upper regolith zone). At Cigar Lake, the course of alteration and hydrothermal activity appears to be much more complete, leading to the extremely high-grade ore accumulations. Mineralization shows the greatest concentrations along fault intersections in breccia and mylonite zones.

The Cigar Lake ore deposit is contained within the Manitou Falls Formation, which makes up the lower unit of the Athabasca sedimentary sequence. The Manitou Falls Formation contains four members designated in ascending order as A, B, C, and D. The main ore body is in the B member. The C member contains much of the perched ore, but the upper limit of mineralization extends to the D member. The A member is absent at Cigar Lake, but is present and well-mineralized at the Close Lake discovery about 17 kilometers to the southwest.

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RECENT DEVELOPMENTS

AUSTRALIA

Australian government officials and uranium producers are expressing quiet confidence about Australia's prospects for entering into significant long-term uranium supply contracts in the foreseeable future. Their reasoning is based on a relatively optimistic view of the short-term future for the uranium market, as follows:

1. International consumer confidence in South Africa could decline while political and social turmoil persists. As a result, Australia will become a more desirable source relative to other suppliers.
2. Supply from secondary sources will phase out over the next two years, causing buyers to turn again to primary producers for supply.
3. Demand for primary material will rise within the next two years, especially in Europe, due to increased economic activity and a re-emerging focus on long-term contracts.
4. Declining US primary production coupled with leveling Canadian exports will shift buyer attention increasingly to Australia as a long-term source. Canadian exports are expected to reach a plateau as new low-cost mines will begin to replace high-cost production in the domestic market.

To the extent that these perceptions materialize, the prospects of new sales improve for both Ranger and Roxby Downs. However, Roxby Downs still must overcome marketing obstacles to the achievement of its projected startup schedule, not only in uranium, but in the equally difficult copper market.

Consistent with a heightened sense of optimism in Australia, Roxby Downs and ERA (Energy Resources of Australia, the Ranger owners) evidently stepped up commercial activities in recent weeks.

1. ERA has announced two uranium contracts for a reported total value of US$190 million. It will supply Korea Electric Power Company and an unnamed US utility with approximately 6.3 million pounds U_3O_8. Deliveries are likely to commence in the early to mid-1990s. Since the contracts have received government approval, prices are expected to conform to the Australian floor price, currently frozen at US$31 per pound U_3O_8.
2. ERA has also announced its decision to expand production capacity approximately 10 million pounds (4,500 metric tons) U_3O_8 by 1988. Further expansion to 13 million pounds (6,000 metric tons) is likely to be under way by 1990. The original design and construction of the treatment plant made provision for a doubling of capacity, so this announcement has been expected for some time.
3. Olympic Dam/Roxby Downs partners have been trying hard to put in place uranium contracts before this December's anticipated date for commitment to project construction. In their view, the copper market poses no problem because the projected annual output of 55,000 metric tons is a very modest portion of the total market.

The optimism being expressed by the Australians must, however, be tempered by consideration of market realities. Foremost among them is the difficulty of executing a meaningful long-term contract when burdened by the government-imposed requirement for a floor price that is nearly twice the level of current spot market prices. Failing a substantial near-term increase in spot market prices, it is likely that consumers will continue to insist on contracts containing options or so-called walk-away provisions. While they may agree to token early deliveries at floor prices, buyers generally will not agree to pay well above spot prices for firm quantities over the entire life of a long-term contract.

* * *

ERA's Ranger mine, located in the Northern Territory, is taking precautions to ensure that its uranium production is not hampered by environmental conditions. At issue is its water management system and a strict "no release" policy dictated by the constraints of an environmentally sensitive area.

Because the mine is surrounded by the Kakadu National Park, specific environmental controls were attached to the mining lease. These included soil and vegetation cover conservation and restoration measures, and no release of water until practical release standards are developed and accepted by supervising authorities. Rainfall has been slightly greater than expected, and evaporation has been slightly less than expected. Thus, after five years of operation, the water management system is approaching capacity levels, storing almost 1.5 million cubic meters of water.

Ranger officials have implemented stopgap measures to give authorities time to consider the options. The use of stockpiled ore allows the mill to continue operating when the open pit is inaccessible due to excess water. Moreover, uranium deliveries have been maintained ahead of schedule. According to ERA, it has enough capacity to handle the next wet season, but some government sources believe the limits have been reached. In their view, only an early release of a substantial quantity of water will allow Ranger to establish another buffer stockpile during the next

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dry season to protect against production losses. However, discharging water from the Ranger catchment into the Magela River system is environmentally and politically sensitive, and repeated releases are especially unpopular. Aboriginal groups and Wildlife Services are opposed to any release of water. Ranger officials are aware that too much pressure for a once-only release, although helpful, could harm Ranger's prospects for obtaining an established water policy with better long-term operating flexibility. Although an interruption of production at Ranger, if it extended long enough, could further weaken Australia's reputation for supply reliability, the politically expedient solution might very well lead to that very eventuality.

* * *

The Australian government is considering its response to a proposal from Euratom to permit *origin swaps* (book transfers) of Australian-origin uranium. On two previous occasions Australia refused to approve such transfers. Because origin swaps had not been envisaged when Australia entered into bilateral agreements with user nations, a specific policy had not been developed, nor had the safeguards implications been examined. A recurring item in discussions with Euratom this year, this issue may now be close to a resolution after careful technical and political scrutiny, hopefully before the next consultative meeting with Euratom in December.

SOUTH AFRICA

Introduction

Last month's Report (#205, September 1985) discussed recent events associated with South Africa's mounting economic crisis, including the short-lived strike by the National Union of Mineworkers (NUM) and external pressure for reforms. Over the past weeks, pressure from the international community has continued, and on several occasions hopes have arisen that the Pretoria government would announce concrete reforms. The South African business community, by making direct contact with black leaders, has put pressure on the government to work out solutions to the civil unrest. However, Pretoria's concessions have yet to convince observers in either South Africa or the international community that real progress on the important issues is imminent.

Government Actions

In a series of four meetings of the ruling National Party in September, State President P.W. Botha announced vague offers of reform. The measures included in the offers, if fully implemented, might result in major changes in the apartheid structure. In mid-September, Botha declared that citizenship would be granted to those blacks who live in the segregated "homelands," and a presidential commission recommended the abolition of so-called pass laws, the regulations that restrict and control the movement of blacks throughout the country. At the end of the month, Botha designated his agenda for implementing such reforms as political rights for blacks, which could include an undefined vote.

Nevertheless, his remarks carried so many qualifications and contingencies that it is difficult to determine what effect the changes will have. Botha proposed continued segregation of schools and housing, stressing that the homelands would not be dismantled, and an aide clarified that citizenship for blacks did not imply political rights for those in the homelands. Consequently, black leaders condemned the ambivalent announcements and called for genuine reforms including power-sharing and an end to apartheid.

On October 2, Botha warned that he will not repeal the Group Areas Act, which prevents blacks, Indians, and persons of mixed race from living in white residential areas. It also forbids non-whites from owning property in white areas and assigns living areas to each racial group. The act, the pass laws, and the population registration laws, together form the basis of apartheid. Although a government commission has recommended the abolition of the pass laws, Botha's adamant refusal to repeal the Group Areas Act indicates the government's intransigence on the fundamental issues of apartheid.

International Reactions

Evidently unconvinced by Botha's earlier remarks, the European Community (EC), with the exception of Britain, in mid-September instituted limited sanctions against South Africa. Similar to the sanctions outlined in President Reagan's Executive Order of September 9, the EC sanctions for the most part reiterated restrictions already in force. Member states withdrew their military attaches from Pretoria, banned arms and oil sales, and halted nu-

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clear cooperation and sensitive technology sales. The sanctions were considered the maximum possible at the time in light of concerns about the large numbers of European citizens residing in South Africa. Two weeks later, after further study, Britain joined the EC in imposing sanctions.

In the USA, President Reagan presented a follow-up measure to his Executive Order by banning the importation of Krugerrand gold coins. Considered the most stringent sanction so far, in that South Africa derives half its foreign exchange earnings from Krugerrand sales, Reagan had promised to add the ban to the sanctions if such an action met little resistance from the General Agreement on Tariffs and Trade, a Swiss-based body that monitors world trading rules.

A bill was introduced in California that would have prohibited investor-owned public utilities from:

1. Selling or furnishing any nuclear, telecommunications, or alternative energy technology to South Africa;
2. Importing or using uranium of South African or Namibian origin for nuclear power plant operation.

The legislation, which had been under discussion for two months and passed in both houses of the California legislature, would have had no immediate impact on either of the state's investor-owned utilities. Nevertheless, the governor of California vetoed the bill. Plans to resurrect the bill or attempt to override the veto have not been announced.

South African Business Efforts

Business leaders are applying increasing pressure on the Pretoria government to institute reforms, and recently took measures to circumvent the government's handling of the matter. In mid-September, a group of businessmen met in secrecy with representatives of the outlawed African National Congress (ANC) to discuss the future of the country. The government condemned the meeting. However, in light of the increasing criticism of the government and concern over the falling value of the rand, the business leaders see themselves as ahead of the government in acknowledging that real reform, without conceding abrupt black rule, is vital to their interests and the country's economic welfare.

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PRIMARY MARKET CONVERTERS: ELDORADO

Introduction

Eldorado Resources Limited of Canada operates one of the five commercial uranium conversion plants in the western world.[1] Its facilities refine natural uranium concentrates (U_3O_8) to UO_3 at one location, and at another location convert the UO_3 either to UF_6 destined for eventual enrichment or to UO_2 for use in Canadian heavy-water (Candu) reactors. Its facilities also are capable of producing 2,500 metric tons of uranium metal per year. Eldorado Resources Ltd. is a wholly owned subsidiary of Eldorado Nuclear Ltd., a Canadian crown corporation whose other operations include uranium mining, milling, and exploration. Since 1980, Eldorado Resources Ltd. has invested C$250 million toward expanding its uranium processing and conversion facilities. In September 1983, a new uranium refinery began operation in Blind River, Ontario (Figure 8). The final stage of the expansion occurred during 1984 when construction of a new UF_6 conversion plant was completed at Port Hope, Ontario (Figure 9). The UF_6 plant capacity is twice that of the old Port Hope facility, but lower volumes of uranium feed have increased unit production costs at the new plant, and the worldwide excess of conversion capacity has led to market weakness. Table 1 lists total uranium processed by Eldorado since 1980.

Blind River Refinery

At the Blind River facility, uranium concentrates are refined into uranium trioxide (UO_3). The plant, commissioned in September 1983, has an annual capacity of 18,000 metric tons uranium (MTU). The refinery receives all types of concentrates, including diuranates of sodium, ammonium, and magnesium. Depending on the mineralogy of the orebody and the milling process used, impurities remaining in the concentrates vary widely. Subject to the conditions of standard acceptance specifications, those impurities are removed in the refining process.

The refining process begins with concentrate sampling to ensure accurate measurement of the concentrates received. Eldorado utilizes the auger method, in which an auger enclosed in a pipe is inserted into each of the 205-liter (approximately 55-gallon) drums of concentrates to remove a sample for analysis. The concentrates are measured for moisture content, uranium content, and impurities, as well as overall weight. Eldorado provides samples to the supplier for uranium determination. The analyses of the supplier and Eldorado are exchanged, and if the results differ by more than 0.21 percent uranium, an umpire analysis is initiated. The choice of umpire for uranium or impurity analysis is by mutual agreement between Eldorado and the supplier.

Following a sampling, the concentrates are blended to produce a uniform feed that reduces processing problems associated with the variations in the chemical properties of concentrates. Refining concentrates to UO_3 consists of the following steps, illustrated in Figure 10.

1. **Digestion**—The concentrates are added to a nitric acid solution in a cascade system, where the material is digested at 80° C. The acid reacts with the uranium in the concentrates to produce uranyl nitrate.
2. **Solvent Extraction**—The impure uranyl nitrate solution then enters an extraction column in which flows a solvent, tributyl phosphate (TBP). The TBP, diluted with kerosene to 25 percent, flows upward in the column as the impure uranyl nitrate flows downward, thereby extracting pure uranyl nitrate. Impurities and excess acid are discharged in the raffinate stream. Second and third columns wash the uranyl nitrate with water, where it separates from the TBP solvent, which is recycled. A pure uranyl nitrate solution, containing 10 percent uranyl nitrate and 90 percent water, flows to the evaporator. The nitric acid is recovered from the raffinate and the concentrated raffinate is returned to nearby uranium mills which recover the residual uranium.
3. **Evaporation**—The uranyl nitrate solution enters a series of three evaporators. The solution is heated to evaporate the water, and the uranium concentration is increased to 75 percent.
4. **Denitration**—The concentrated solution is fed into heated denitration vessels, where the remaining water

Table 1

TOTAL URANIUM PROCESSED AT ELDORADO 1980-84

Year	Production (MTU as UF_6 and natural UO_2)	Percent Change
1980	5,211	—
1981	5,990	+15
1982	6,339	+ 6
1983	5,564	-12
1984	4,399	-21

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[1] The others are Allied Chemical, BNFL (British Nuclear Fuels Ltd.), Comurhex, and Sequoyah Fuels.

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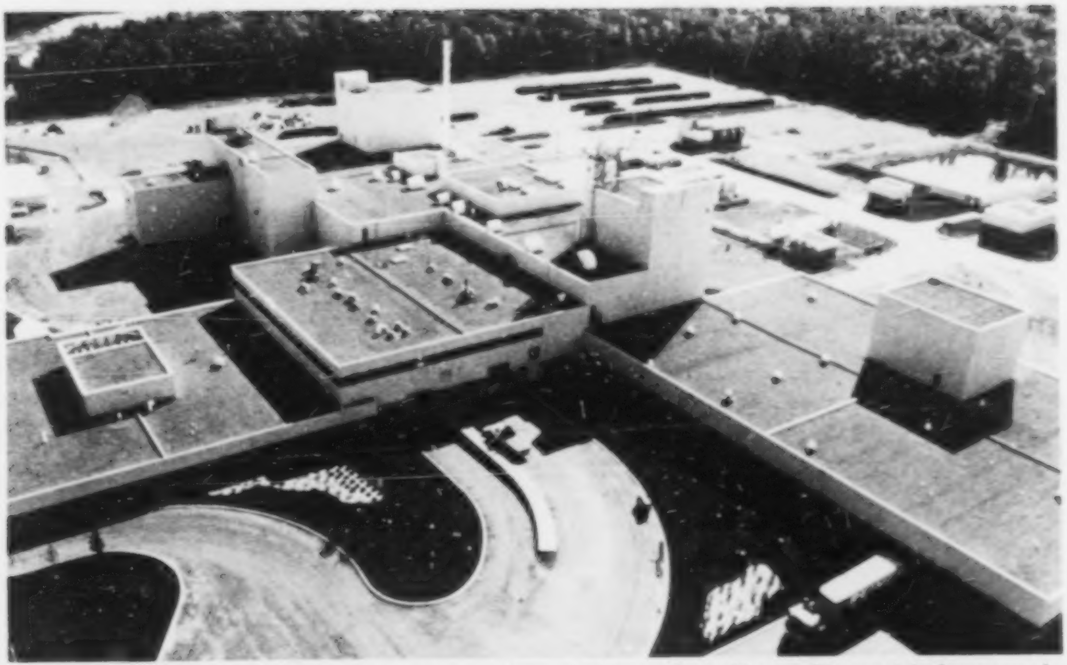

Figure 8. The Blind River UO$_3$ refinery sits on the north shore of Lake Huron. The truck in foreground is unloading U$_3$O$_8$ for storage. UO$_3$ product is shipped from upper left end of the building.

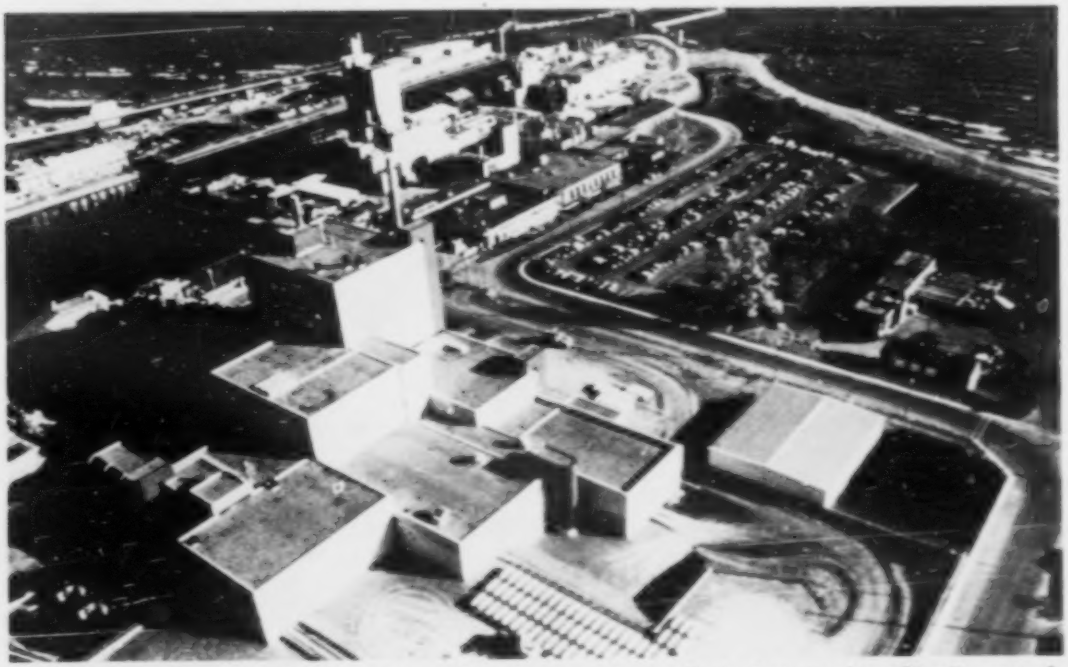

Figure 9. The Port Hope UF$_6$ plant, located on the north shore of Lake Ontario about 70 miles east of Toronto. The active UF$_6$ plant is in the foreground, with the old plant directly behind it.

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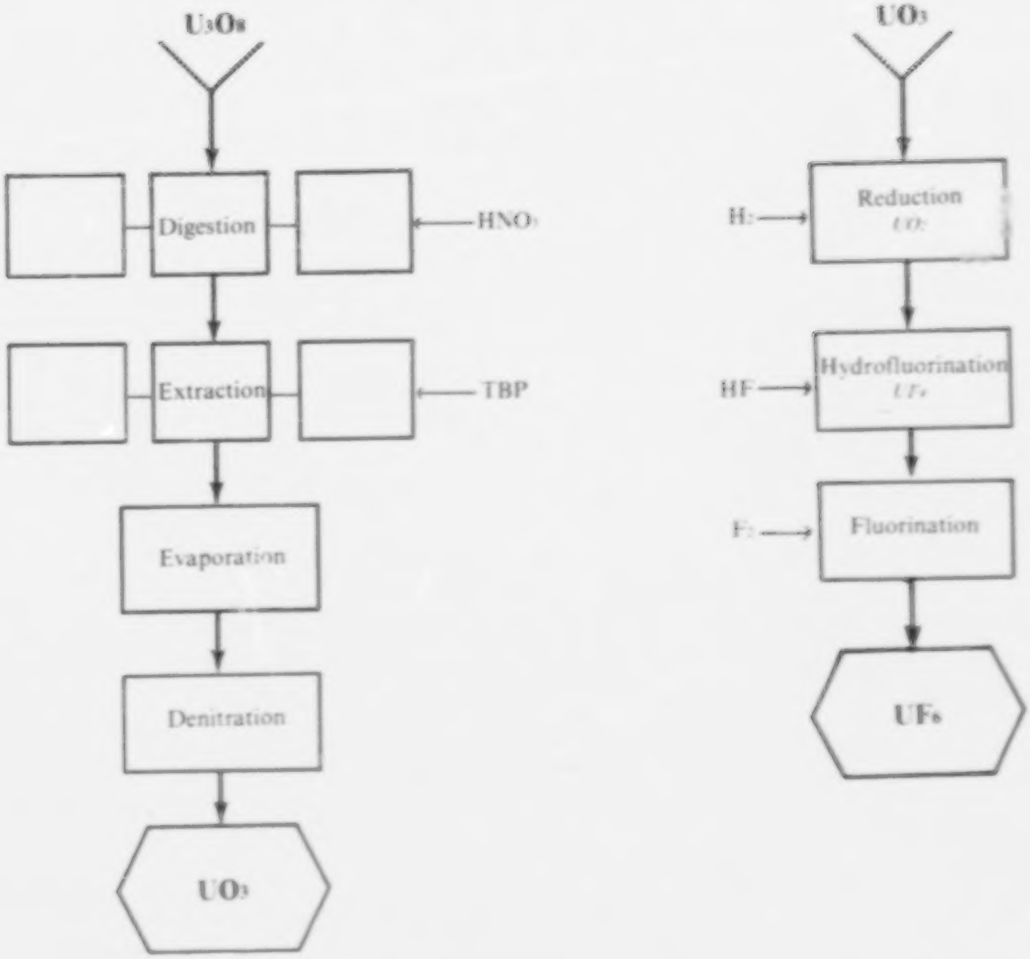
U3O8
Digestion
HNO3
Extraction
TBP
Evaporation
Denitration
UO3
UO3
H2
Reduction
UO2
HF
Hydrofluorination
UF4
F2
Fluorination
UF6

Figure 10. Blind River refining process, left, and Port Hope conversion process, right.

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evaporates and the uranyl nitrate thermally decomposes into uranium trioxide (UO_3) and gaseous nitrogen oxides. The nitrogen oxides are piped to an acid recovery process for eventual reuse, while the pure UO_3 powder is packed into 10-metric-ton bins for shipment by truck to the Port Hope facility (Figure 11). The trucks can carry three bins each.

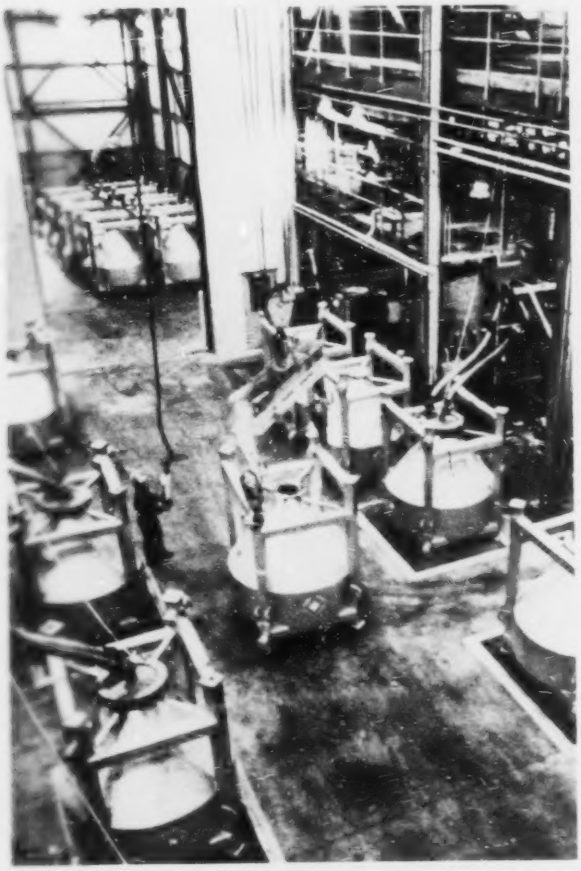

Figure 11. View of the UO_3 loading bay of the Blind River River refinery. UO_3 is loaded into 10-tonne containers for shipment to Port Hope.

Port Hope Conversion Facility

Most of the UO_3 produced at the Blind River facility is converted to uranium hexafluoride (UF_6) at Port Hope. At the new 9,000-MTU facility, the UO_3 powder is introduced into a fluid-bed-reduction reactor (Figure 10). The UO_3 is suspended in the reactor by hydrogen gas, which reduces the UO_3 to uranium dioxide (UO_2). The UO_2 powder is fed into wet reactors, where it is contacted with aqueous hydrofluoric acid (HF), which converts the UO_2 to uranium tetrafluoride (UF_4). The UF_4 is then filtered and dried before it is fluorinated in a flame reactor with fluorine gas (F_2) to produce UF_6. The fluorine is produced at the plant by means of the standard electrolytic process using 12,000-amp cells. The HF recovered from off-gas streams is recycled for the hydrofluorination process.

Cold traps (heat exchangers) cool and condense the gaseous UF_6 into white crystals. The solid is heated slightly to liquefy it, enabling it to be poured into 13-metric-ton steel shipping cylinders where it resolidifies. The material then is ready for shipment to enrichment plants in Europe and the USA.

Conversion to UO_2

Approximately 20 percent of the uranium Eldorado refines is converted to ceramic-grade uranium dioxide for use in Candu heavy-water reactors, which utilize natural uranium. The feed product used is pure uranyl nitrate, produced by dissolving the UO_3 end-product of the Blind River plant in nitric acid.

The uranyl nitrate is precipitated with ammonia to produce a slurry. Solid ammonium diuranate (ADU) is separated from the slurry, dried, and reduced with hydrogen in rotary kilns, producing ceramic-grade UO_2. The product is blended and packaged in 55-gallon drums for shipment to Canadian fuel fabricators. Ammonium nitrate recovered from the UO_2 process is sold as agricultural fertilizer.

The Blind River plant finished its first full year of operations in 1984, meeting the feed requirements of the Port Hope operations. Two factors, however, accounted for a 20-percent decline in total uranium processed by Eldorado in 1984.

1. The commissioning of the Port Hope plant resulted in lower than expected UF_6 production.
2. The shutdown for repairs of two reactors at Ontario Hydro's Pickering station reduced the need for ceramic-grade UO_2.

Several factors were involved in Eldorado's decision to begin expansion of its conversion facilities. In the mid-1970s, when forecasts indicated that rapidly increasing numbers of nuclear power plants would require greater conversion capacity, Eldorado officials determined that the old Port Hope facility was too small and outdated to continue to support a growing uranium production industry. Thus, plans for the Blind River facility emerged. In

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more recent years, assumptions that Canadian mine production would grow substantially and that the federal government upgrading requirement would remain in effect figured in the decision to expand capacity. Indeed, Canadian U_3O_8 production increased to approximately 29 million pounds in 1984, an increase of over 10 million pounds from 1983; Canada surpassed the USA in production for the first time to become the world's largest producer.

Although the Canadian government's upgrading requirement policy is still in effect, the government has granted numerous exemptions in recent years, especially to US utilities preferring U_3O_8. In such cases, utilities have been allowed to import Canadian U_3O_8 and convert it in the USA under existing contracts with US converters. (See Report 202, June 1985, page 24, for a discussion of the implications of US attempts to impose protectionist legislation aimed at Canada's upgrading policy.) The government considers exemptions provided certain conditions are met, and in recent months, exemptions under these conditions have been virtually automatic. Ultimately, in view of Canada's position as the world's leading uranium-producing country, the government probably will take a pragmatic approach to implementation of its upgrading policy to assure that the country's uranium sales are not unduly jeopardized. A Canadian government spokesman has indicated that the current review of uranium export policy will probably produce a more precise definition of the conditions under which exemptions will be granted.

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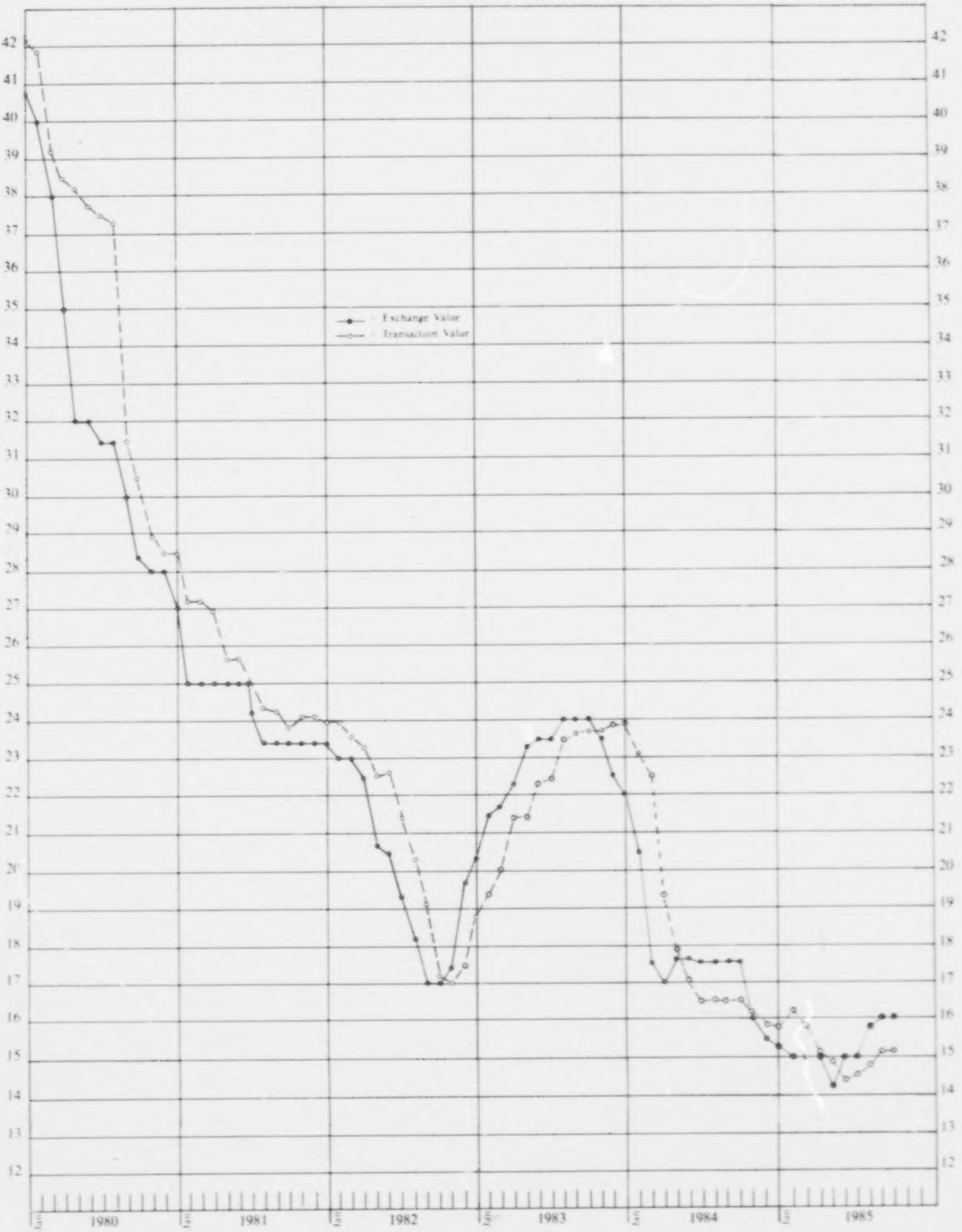
HISTORICAL MARKET DATA

EXCHANGE AND TRANSACTION VALUES SINCE JANUARY 1980

Determined as of the last day of the month indicated



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HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	—	—	—	—	—	—	—	6.35	6.35	6.40	6.45	6.50
1969	—	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	32.50	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00
1981	25.00	25.00	25.00	25.00	25.00	24.25	23.50	23.50	23.50	23.50	23.50	23.50
1982	23.00	23.00	22.50	20.75	20.50	19.25	18.25	17.00	17.00	17.50	19.75	20.25
1983	21.50	21.75	22.25	23.25	23.50	23.50	24.00	24.00	24.00	23.50	22.50	22.00
1984	20.50	17.50	17.00	17.75	17.75	17.50	17.50	17.50	17.50	16.00	15.50	15.25
1985	15.00	15.00	15.00	14.25	15.00	15.00	15.75	16.00	**16.00**			

HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	—	—	—	—	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38.40	37.90	37.60	37.30	31.60	30.60	29.00	28.70	27.70
1981	27.20	27.20	27.00	25.70	25.70	24.50	24.40	24.30	23.90	24.10	24.10	24.00
1982	24.00	23.70	23.40	22.60	22.70	21.50	20.30	19.10	17.30	17.00	17.55	18.80
1983	19.35	20.00	21.35	21.40	22.35	22.45	23.50	23.60	23.65	23.65	23.85	23.85
1984	23.05	22.50	19.25	17.90	17.00	16.50	16.60	16.40	16.55	16.05	15.90	15.90
1985	16.20	15.70	15.05	14.90	14.45	14.60	14.75	15.10	**15.10**			

HISTORICAL CONVERSION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U as UF_6)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	1.20	1.20	1.20	1.40	1.15	1.15	1.15	1.10	1.10	1.10	1.20	1.20
1982	1.20	1.20	1.20	1.20	1.00	1.00	1.00	0.90	1.10	1.60	1.45	1.45
1983	1.20	1.40	1.40	1.20	1.20	1.20	1.10	1.10	1.00	0.60	0.60	0.60
1984	0.60	0.30	0.80	0.80	0.80	0.00	0.00	0.80	1.00	1.00	0.80	0.80
1985	1.00	1.00	1.00	1.50	1.50	1.60	1.60	1.60	**1.60**			

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GOVERNMENT STATISTICS

AUSTRALIA

	Price Index of Materials Used in Manufacturing Industry—All Groups[1] (1969=100)	Award Rates of Pay Indexes Australia—Adult Males In Mining Wage and Salary Earners, Weekly Rates[2] (1976=100)
1983 Avg.	401.2	181.8
Jun 1984	404.7	197.4
Jul 1984	408.3	197.4
Aug 1984	413.1	197.4
Sep 1984	411.9	197.4
Oct 1984	408.4	197.4
Nov 1984	407.1	197.4
Dec 1984	405.9	197.4
Jan 1985	409.3	197.4
Feb 1985	416.0	197.4
Mar 1985	429.4	197.4
Apr 1985	440.2	202.3
May 1985	451.8	202.3
Jun 1985	—	202.4

P = Preliminary R = Revised since last month

CANADA

	Industry Selling Price Index: Manufacturing[1] (1971=100)	Wage-earner Data: Average Hourly Earnings (C$)[2]					
		Uranium Mines (SIC 057)	Metal Mines* (SIC 051-059)	Mines, Quarries and Oil Wells[3] (SIC 051-099)	Primary Metal Industries Non-ferrous[4] (SIC 296)	Primary Metal Industries Non-ferrous[4] (SIC 298)	Chemicals and Chemical Products[5] (SIC 372-379)
1983 Avg.	298.8	—	—**	14.30	—	—	11.17
Aug 1984	312.7	17.24	15.36	14.92	12.44	10.34	11.78
Sep 1984	312.3	17.68	15.96	15.34	12.51	10.52	11.90
Oct 1984	312.3	17.64	16.15	15.26	12.69	10.56	11.96
Nov 1984	313.6	18.04	16.13	15.43	12.47	10.51	11.96
Dec 1984	314.2	17.95	16.39	15.60	12.16	10.40	11.99
Jan 1985	315.8	18.05	16.13	15.60	12.32	10.80	12.04
Feb 1985	316.5	18.78	16.41	15.68	12.52R	11.05	12.06
Mar 1985	318.0R	18.24	16.21	15.57	12.43	10.97	12.02
Apr 1985	318.2	18.63	16.44	15.80	12.81	11.23	12.04
May 1985	318.8	19.41.	16.51	15.63	12.76	11.25	12.15
Jun 1985	318.7R	18.49	16.20	15.49R	12.89	11.14R	12.14R
Jul 1985	318.9R	18.14P	15.99P	15.43P	13.00P	11.08P	12.14P
Aug 1985	318.8	—	—	—	—	—	—

P = Preliminary R = Revised since last month

For annual averages prior to 1983, and for notes pertaining to these statistics, see pages 23-26 of Report 190 of June 1984.

*The 1980 average for Metal Mines was incorrectly reported as 10.59. The correct average is 10.58 (see Report 190).

**Two different methods were used in the 1983 "Metal Mines" category in reporting survey data, and Statistics Canada did not publish a 1983 average. The March 1983 figure for the old method was 14.73 and for the new method was 14.84. The published average for 1983 in Report 190 was a Nuexco calculation based on the available monthly statistics for 1983 with the exception of the March figure, where only the 14.84 value was taken into account.

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REPUBLIC OF SOUTH AFRICA

	Average Declared Working Costs per per Metric Ton of Gold Ore Milled (Rand)[1]	Tonnage-Weighted Index of Average Working Costs per Metric Ton of Gold Ore Milled (March 1982=100)[2]	Consumer Price Index[3] (1975=100)[4]	Producer Price Index All Groups[5] (1975=100)	Total Employment in Mining and Quarrying (Code 35)[6]	Total Salaries and Wages in Mining and Quarrying (1,000 Rand) (Code 40)[6]
1983 Avg.	51.87	115.0	262.2	274.8	696,579	3,644,772
Jun 1984	56.95	126.2	291.2	295.3	717,009	347,121
Jul 1984	—	—	295.1	296.0	717,121	369,964
Aug 1984	—	—	297.0	300.8	721,905	361,357
Sep 1984	60.64	133.2	299.9	304.1	721,470	359,218
Oct 1984	—	—	303.7	308.7	717,865	363,755
Nov 1984	—	—	307.4	312.8	717,396	369,771
Dec 1984	62.92	138.6	309.4	315.9	701,198	365,234
Jan 1985	—	—	177.1*	166.6*	711,366	376,777
Feb 1985	—	—	182.8*	171.3*	727,932	361,823
Mar 1985	64.48	142.4	183.6*	173.0*	708,809	371,380
Apr 1985	—	—	187.4*	174.0*	724,187	369,005
May 1985	—	—	189.5*	177.7*	708,085	373,478
Jun 1985	67.42	148.9	191.9*	179.2*	—	—
Jul 1985	—	—	193.6*	180.7*	—	—
Aug 1985	—	—	195.6*	—	—	—

*The basis for calculation for these indices has been revised to January 1980 = 100.

UNITED STATES

	Producer Price Index[1]		Consumer Price Index[2]	GNP Implicit Price Deflator[3]	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[4]			
	Industrial Commodities (1967=100)	All Commodities (1967=100)	(1967=100)	(1972=100)	Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)	Electric and Electronic Equipment (SIC 36)
1983 Avg.	315.8	303.1	298.4	215.63	12.57	13.43	10.59	8.65
Jul 1984	324.0	312.0	311.7	—	13.02	13.36	11.12	8.95
Aug 1984	323.5	310.9	313.0	—	13.10	13.51	11.13	9.00
Sep 1984	322.3	309.5	314.5	224.57	13.20	13.39	11.23	9.08
Oct 1984	323.2	309.4	315.3	—	13.23	13.53	11.32	9.09
Nov 1984	323.8	310.4	315.3	—	13.23	13.76	11.35	9.15
Dec 1984	323.0	309.9	315.5	226.10	13.28	13.66	11.37	9.27
Jan 1985	322.9	309.5	316.1	—	13.29	13.70	11.39	9.33
Feb 1985	322.5	309.2	317.4	—	13.30	13.73	11.39	9.33
Mar 1985	322.6	308.7	318.8	229.07	13.29	13.95	11.37	9.39
Apr 1985	323.8	309.3	320.1	—	13.43	13.62	11.48	9.40
May 1985	325.3	309.9	321.3	—	13.24	13.59	11.46	9.39
Jun 1985	324.7	309.1	322.3	230.55R	13.23R	13.66R	11.52R	9.46R
Jul 1985	324.3	309.0	322.8	—	13.45P	13.82P	11.60R	9.47R
Aug 1985	323.6	307.2	323.5	—	13.45P	13.70P	11.63P	9.52P

P = Preliminary R = Revised since last month

For annual averages prior to 1983, and for notes pertaining to these statistics, see pages 23-26 of Report 190 of June 1984.

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NUEXCO

EXECUTIVE SUMMARY
REPORT 206
(All data as of September 30, 1985)

Exchange Value $16.00, unchanged	The **Exchange Value** is **$16.00** per pound U_3O_8, unchanged since last month.
UF_6 Value $44.50, unchanged	The **UF_6 Value** is **$44.50** per kilogram U as UF_6, unchanged since last month.
Transactions	Four recent natural uranium sales are reported, involving approximately 300 thousand pounds U_3O_8 equivalent. All of the sales involved spot or near-term delivery and three met the conditions for inclusion in the Transaction Value. Two of the sales involved natural UF_6.
Supply-Demand Ratio fell to 1.9:1	Active spot and near-term **uranium supply** amounts to **2.1 million** pounds U_3O_8 equivalent, down 1.2 million pounds since last month. Active spot and near-term **uranium demand** totals **1.1 million** pounds, down 105 thousand pounds. The spot and near-term **supply-demand ratio** fell to **1.9:1.**
Transaction Value unchanged at $15.10	The **Transaction Value** is **$15.10** per pound U_3O_8, unchanged since last month. The calculation includes 17 transactions involving a total of 2.7 million pounds U_3O_8 and equivalent UF_6, and covers a period of 4 months.
Loan Use Charge Rate unchanged at 5%	The **Loan Use Charge Rate** is **5 percent** per annum, unchanged.
Conversion Value unchanged at $1.60	The **Conversion Value** is **$1.60** per pound U as UF_6, unchanged since last month. Active secondary market supply for conversion services for delivery within three years totals 100 thousand pounds U as UF_6. No active demand is reported.
SWU Values: **$85 for DOE-origin for delivery by the end of FY86** **$78 for non-DOE origin for delivery by the end of calendar year 1986**	The **SWU Value** for DOE origin at .3 tails and certifiable as excess, is **$85** per SWU for delivery by the end of FY86. The SWU Value for other SWUs (non-DOE or non-certifiable) is **$78** per SWU for delivery by the end of calendar year 1986. Three secondary market SWU transactions are reported, involving 50 to 100 thousand SWUs.
Pricing	Analyzes effects of recent rulings that USEC is invalid and that US uranium production industry is not viable.
Raw Materials	Canada's Cigar Lake is the largest high-grade uranium deposit in the world. Its discovery has reshaped the future of the Canadian uranium industry. The mining plan probably will combine conventional procedures, augmented by techniques designed to overcome the special circumstances of high-grade ore and unstable ground conditions.
Australia	Australians, believing that Australia's prospects for entering into significant long-term uranium contracts are improving, have stepped up commercial efforts. Their optimism must be tempered, however, by recognition of the burden that is imposed by the government's insistence on a US$31 floor price.
South Africa	Although Pretoria has proposed various concessions toward blacks, they have been so qualified and vague that observers remain unconvinced. South African business leaders have put pressure on the government to institute meaningful reforms, but the violence and the economic crisis continue.
Focus	Eldorado Resources Limited of Canada, one of five providers of conversion services (U_3O_8 to UF_6) for the commercial market, recently completed an extensive expansion of its facilities. The implementation of the Canadian government's upgrading policy will affect Eldorado's conversion market as Canadian uranium production increases.

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NUEXCO REPORT 206 FIGURES OF THE MONTH (September 30, 1985)	This Month (Report 206)	Last Month (Report 205)	12 Months Ago (Report 194)
Exchange Value[1]	16.00	16.00	17.50
Transaction Value[1]	15.10	15.10	16.55
UF_6 Value[2]	44.50	44.50	—
Loan Use Charge Rate[3]	5%	5%	6%
Conversion Value[4]	1.60	1.60	1.00
Near-Term Uranium Supply[5]	2.1	3.3	5.5
Near-Term Uranium Demand[6]	1.1	1.2	0.1
Near-Term Supply-Demand Ratio	1.9	2.8	5.8
Recent Uranium Sales:			
Number of Transactions[7]	4	3	4
Quantity of Material[8]	0.3	0.4	2.0
Nuexco SWU Values:[9]			
DOE origin, certifiable as excess, 0.3 tails assay, delivery before the end of FY86	85	85	—
Other SWUs (non-DOE or non-certifiable), delivery by the end of calendar year 1986	78	81	—
USDOE SWU Prices:			
USEC	125.00[10]	135.00	135.00
AFC	153.00[11]	153.00[11]	153.00[11]
Requirements	157.00[11]	157.00[11]	157.00[11]
Market Value of Enriched UF_6[12, 13]:			
2.5 w/o U_{235}	459	459	587
3.0 w/o U_{235}	589	589	758
3.5 w/o U_{235}	722	722	932
4.0 w/o U_{235}	857	857	1,109

---

[1] US $ per pound U_3O_8 equivalent.

[2] US $ per kilogram U as UF_6.

[3] Per annum.

[4] US $ per pound U as UF_6.

[5] Active inquiries to sell, for delivery within 12 months after contract signing (millions of pounds U_3O_8).

[6] Active inquiries to purchase, for delivery within 12 months after contract signing (millions of pounds U_3O_8).

[7] Uranium sales only; does not include loans, conversion, or SWU transactions.

[8] Millions of pounds U_3O_8, equivalent.

[9] US $ per SWU.

[10] Effective 10/1/85.

[11] Effective 10/1/84.

[12] Calculated using the Nuexco Exchange Value, Conversion Value, and 0.30 percent tails assay. From 3/30/84 through 4/29/85, calculations used the Nuexco SWU Value for DOE origin and FY85 delivery. As of 4/30/85, calculations use the Nuexco SWU Value for DOE origin and delivery by the end of FY86.

[13] US $ per KgU as UF_6, rounded to the nearest $.

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